

NOV 23 1987

MEMORANDUM FOR: Chairman Zech
 Commissioner Roberts
 Commissioner Bernthal
 Commissioner Carr
 Commissioner Rogers

FROM: Victor Stello, Jr.
 Executive Director for Operations

SUBJECT: CONSIDERATION OF FULL POWER LICENSING OF PALO VERDE UNIT 3 *566*

Consideration of full power licensing of Palo Verde, Unit 3, is presently scheduled for November 25, 1987. Provided for your use is a copy of updated material for the Palo Verde Unit 3 briefing package which was forwarded on October 19, 1987. The updated material includes the following:

1. Revised briefing slides for the full power briefing
2. Revised Attachment 1 to the proposed full power license
3. Proposed Supplement 12 to the Palo Verde Safety Evaluation Report (SER)
4. Background Material on RCP Shaft Cracking Issue

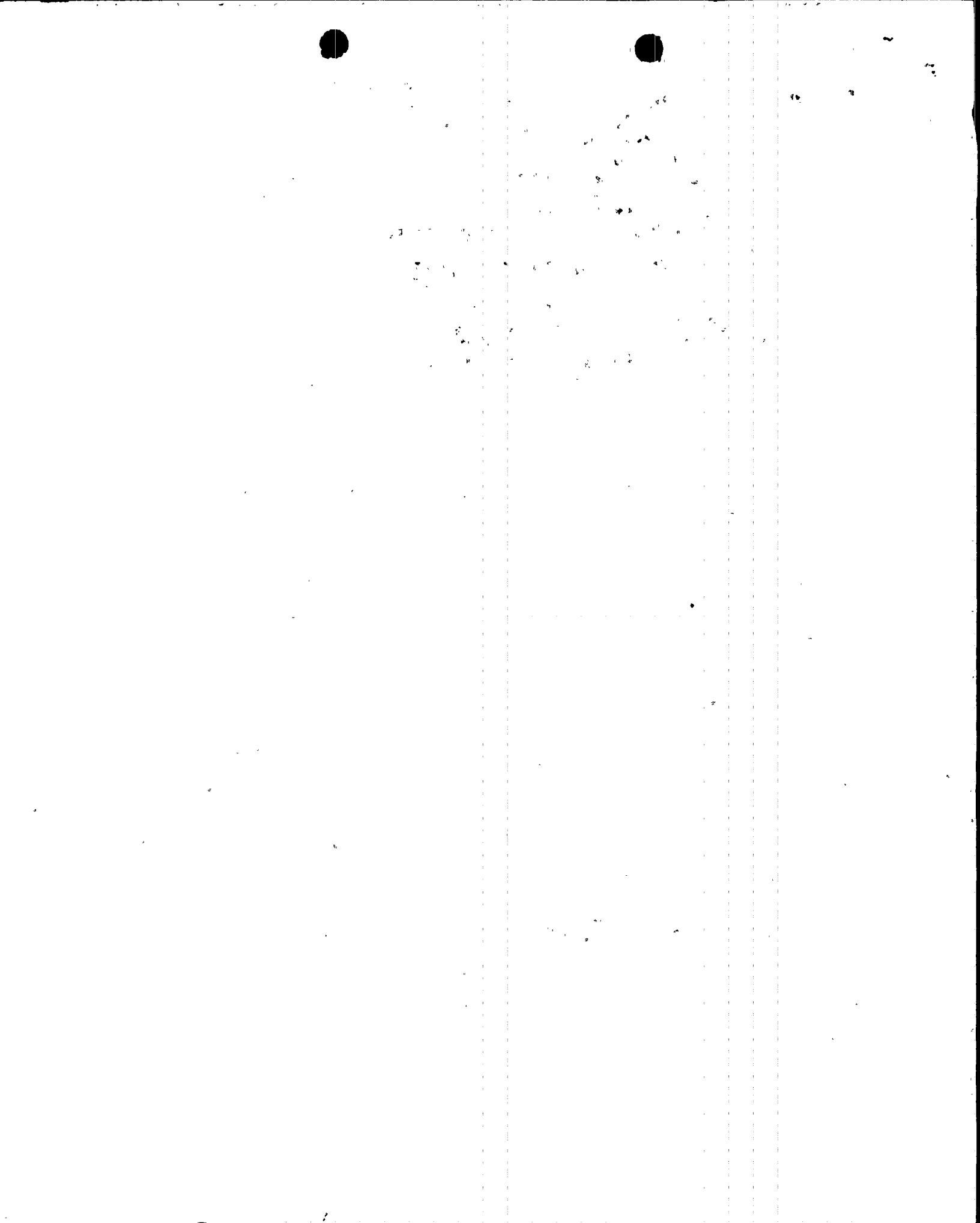
The Commission meeting originally scheduled for October 28, 1987 was postponed pending resolution of two issues; the discovery of cracks on reactor coolant pump shafts during the current Palo Verde Unit 1 refueling outage, and the adequacy of the requalification training program due to high failure rates on requalification exams.

A. RCP Shaft Cracking

During the current refueling outage for Palo Verde Unit 1, inspections of the four reactor coolant pump shafts identified cracks on all four shafts near the keyway area. The shafts were manufactured by KSB in Frankenthal, Germany. In the past two years, cracked shafts have also been found in similar KSB pump designs in several European plants. In two of those cases (Gosgen plant in May 1985 and Grafenrheinfeld plant in December 1986), the cracks in a pump shaft propagated to failure. Since the RCP shaft designs in Palo Verde Units 2 and 3 are identical to Palo Verde Unit 1 and similar to the European KSB designs with cracked shafts, the staff had concerns about continued operation of Units 2 and 3. To address the concerns, the staff met with the licensee on October 24 and November 4, 1987, and on October 28 - 30, 1987 met with representatives of the pump manufacturer, KWU, and GRS in Germany concerning the European experience.

CONTACT:
 M. Davis, NRR
 X28897

8711250278 871123
 PDR ADDCK 05000530
 P PDR



As a result of those meetings, the following actions have or will take place to resolve this issue.

- (1) The licensee has committed to install modified shafts in all three Palo Verde Units during the first refueling outage. Installation is currently in progress at Palo Verde Unit 1.
- (2) The licensee has provided an acceptable justification for continued operation of Palo Verde Units 2 and 3 until modified shafts are installed. The justification is supported by the licensee's commitment to shut down a unit at least one week before the projected date of reaching excessive shaft vibration (10 mils) by using spectral analysis techniques.
- (3) The licensee's commitments have been confirmed by Order on Unit 2 and are included in the proposed full power license for Unit 3.

B. Operator Requalification Results

The quality of the Palo Verde requalification training program was questioned when the NRC was advised on October 19, 1987 that 14 of 35 licensed operators had failed the facility-administered requalification exam of September 23, 1987. Region V conducted an inspection from October 22 - 23, 1987 to look at the requalification training program. A summary of the findings is enclosed.

The high failure rate is due in part to the upgrading of the requalification exams in that seventy percent of the questions were new and the questions were more operationally oriented. In addition, the exams were graded more strictly in response to criticism from recent Region V inspections. The non-shift personnel did not receive structured classroom training, but primarily used old exams as a guide for independent study. The failure rate for non-shift personnel was much higher than the rate for shift personnel on the two requalification exams administered in September 1987. After reviewing the exams, the staff does not feel that the failure rate for shift personnel was abnormally high under these circumstances.



8

22

The licensee is taking a number of corrective actions as detailed in the enclosed summary from Region V. After completion of these corrective actions, Region V will administer a requalification exam in June 1988.

The staff considers the issues of RCP shaft cracking and operator requalification training to be resolved.

Original signed by
Victor Stello

Victor Stello, Jr.
Executive Director
for Operations

ENCLOSURES:

1. Draft SER Input on RCP Shaft Cracking
2. Summary of Inspection - Requalification Training
3. Briefing Slides for Full Power Briefing
4. Revised Attachment 1 to Proposed Full Power License
5. Background Material on RCP Shaft Cracking

cc: Secy
OGC

DISTRIBUTION

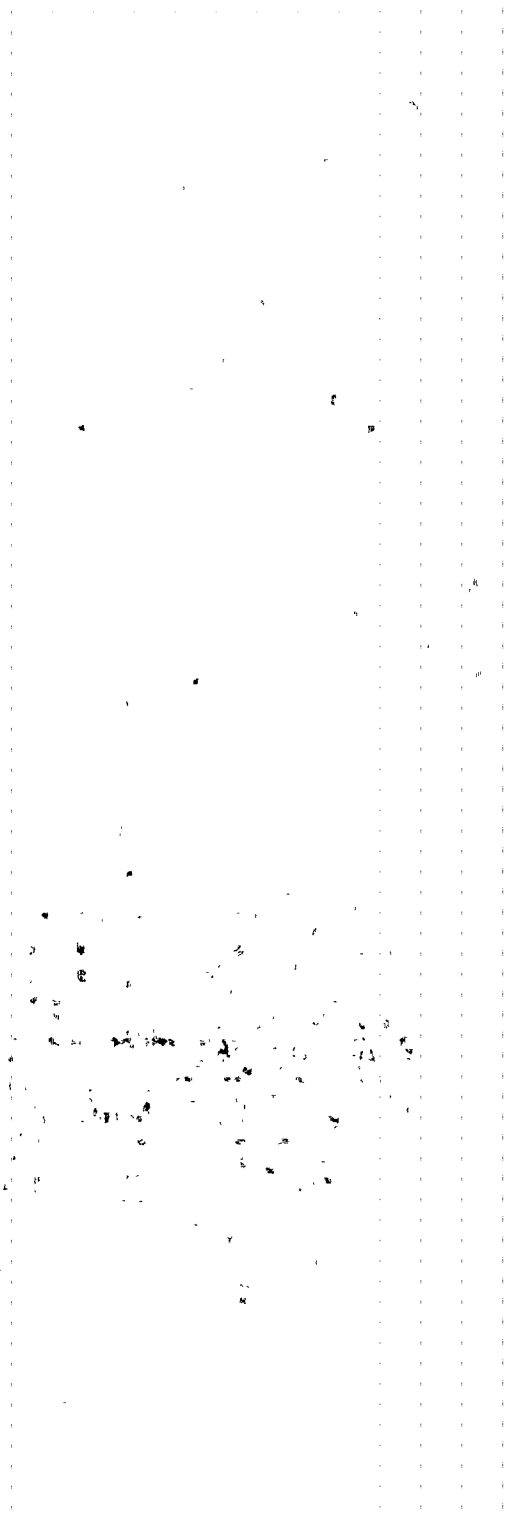
- Docket of Central File
- NRC & Local PDRs
- EDO Reading
- PDV Reading
- T. Rehm
- T. Murley
- F. Miraglia
- D. Crutchfield
- G. Holahan
- J. Heltemes, AEOD
- M. Davis
- J. Lee

*See original concurrence

OFC	*DRSP/PDV	*DRSP/D: PDV	*ADR/DRSP	DRP/DRSP	ABR	DOANR	EDO
NAME	MJDAVIS	GWKNIGHTON	GMHOLAHAN	DMCRUTCHFIELD	FMIRAGLIA	TMURLEY	VSTELLO
DATE	11/18/87	11/18/87	11/18/87	11/18/87	11/18/87	11/19/87	11/23/87

Sign
11/19

[Handwritten signature]



The licensee is taking a number of corrective actions as detailed in the enclosed summary from Region V. After completion of these corrective actions, Region V will administer a requalification exam in June 1988.

The staff considers the issues of RCP shaft cracking and operator requalification training to be resolved.

Victor Stello, Jr.
Executive Director
for Operations

ENCLOSURES:

1. DRAFT SER INPUT ON RCP SHAFT CRACKING
2. SUMMARY OF INSPECTION - REQUALIFICATION TRAINING
3. BRIEFING SLIDES FOR FULL POWER POWER BRIEFING
4. REVISED ATTACHEMENT 1 TO PROPOSED FULL POWER LICENSE
5. BACKGROUND MATERIAL ON RCP SHAFT CRACKING.

DISTRIBUTION

Docket of Central File
 NRC & Local PDRs
 EDO Reading
 PDV Reading
 T. Rehm
 T. Murley
 F. Miraglia
 D. Crutchfield
 G. Holahan
 J. Heltemes, AEOD
 M. Davis
 J. Lee

OFC	: DRSP/PDV	: DRSP/D: PDV	:: ADR DRSP	: DRP/DRSP	: ADP		DONNR	: EDO
NAME	: MJDAVIS	: GKNIGHTON	: GMHOLAHAN	: DMCRTCHFIELD	: FMIRAGLIA		TMURLEY	: VSTELLO
DATE	: 11/18/87	: 11/18/87	: 11/18/87	: 11/ /87	: 11/ /87		: 11/ /87	: 11/ /87

110

7

DRAFT

5.4 COMPONENT AND SUBSYSTEM DESIGN

5.4.1 Reactor Coolant Pumps

Shaft Cracking Experience

By letter dated October 8, 1987, the licensees informed the Commission that European reactor coolant pumps similar to the Palo Verde pumps in design and manufacture had exhibited shaft cracking. Cracks have been found in 21 of 27 European shafts after 22,500 to 64,500 hours of operation and two shafts had failed. The actual failures occurred after 47,500 and 41,500 hours of pump operation. As a result, the licensees informed the Commission that they planned to inspect the shafts of the pumps at Palo Verde Unit 1 during the current refueling outage, October-December 1987. In the licensees' letter of October 21, 1987, they reported that the inspection began on October 14, 1987. Upon completion of an ultrasonic inspection of the shaft of the first two pumps, cracks of varying depths and lengths had been identified. Subsequently, cracks were detected in the two remaining pumps. No shaft failures have been experienced at Palo Verde.

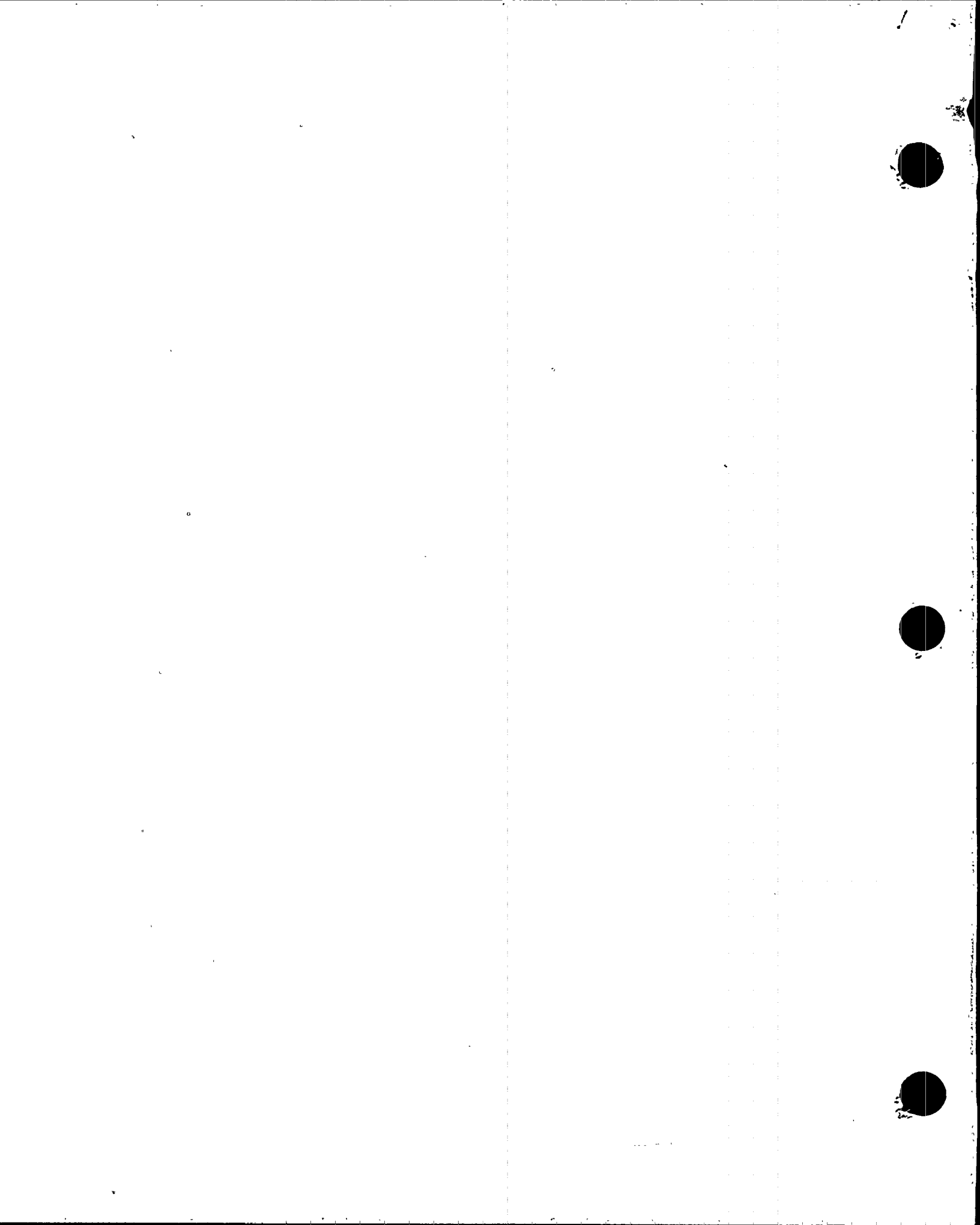
The licensees met with the Commission staff on October 24, 1987, to review the history of pump shaft cracking in Europe, the findings at Palo Verde Unit 1, and to propose actions to be taken with respect to operation of Palo Verde Units 1, 2, and 3.

Following the meeting on October 25, 1987 the Commission issued an immediately effective order confirming licensee commitments on monitoring vibration of RCP shafts at Palo Verde Unit 2 which requires the following:

1. Every four hours, monitor and record the vibration data on each of the four reactor coolant pumps,
2. On a daily basis, perform an evaluation of the pump vibration data obtained in 1 above, by using an appropriately qualified engineering individual,
3. When any one vibration monitor on the reactor coolant pumps indicates a vibration level of 8 mils or greater, the Nuclear Regulatory Commission shall be notified within four hours via the Emergency Notification System, and
4. When any one vibration monitor on the reactor coolant pumps indicates a vibration level of 10 mils or greater, within one hour, initiate action to place the unit in at least HOT STANDBY within the next six hours, and at least COLD SHUTDOWN within the following 30 hours.

Following the meeting teams from APS and the NRC travelled to Germany to investigate European experience with RCP shaft cracking. Another meeting was held on November 4, 1987, to review information gathered in Europe and to review actions taken on the Palo Verde Units.

DRAFT



DRAFT

European Experience - As a result of the trip to Germany the licensee provided the following information concerning European experience with RCP shaft cracking.

In the two European shaft failure events shutdowns were uncomplicated with no failed fuel resulting. One of the plants continued operation at reduced power for a month after the event. The analysis of a single shaft failure for Palo Verde with realistic assumptions as compared to conservative regulatory assumptions shows as expected no fuel failure. The analysis shows lower combined stresses on the unaffected pumps following the single failed shaft event. Therefore, one shaft failure should not result in an increased probability that another shaft would fail.

Vibration amplitude monitoring experience from plants that have experienced failed shafts indicates that vibration monitoring should provide indication of impending shaft failure at least 48 hours prior to the event. Advanced vibration monitoring techniques such as spectrum analysis to determine frequency shifts could provide earlier warning of serious shaft defects.

European metallurgical and fractographic evaluations indicate that fatigue cracking initiates in the chrome plating due to normal operating and thermal stresses. The microcracks developed in the chrome plating then act as stress raisers to initiate cracks in the base metal. The cracks in the base metal then propagate by high cycle fatigue.

The results of inspections performed on Palo Verde Unit 1 RCP shafts showed indications of cracking near the top of the keyway with operating times between 17,500 and 19,400 hours. The Palo Verde experience is generally consistent with the European experience.

Shaft Modification

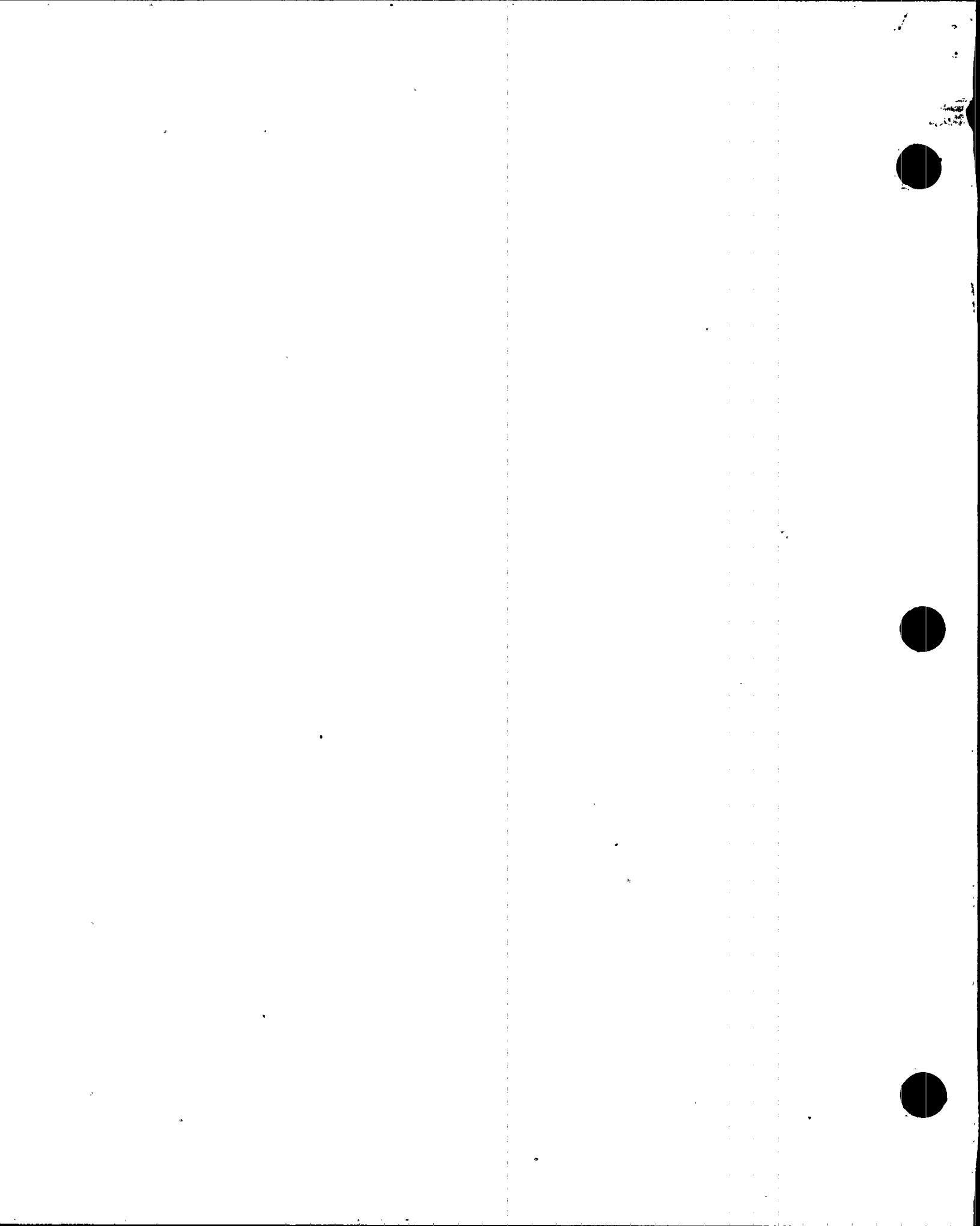
After the European trip the licensees came in to present their findings with respect to continued operation of Units 2 and 3 at a meeting on November 4, 1987.

The Palo Verde Unit 1 RCP shafts are being replaced with modified spare shafts. The modifications consist of (1) removal of the chrome plating in all moderate to high stress areas where cracking has been experienced, (2) extending the stop seal to prevent thermal shock of direct seal water impingement on the shaft, and (3) shortening of the key to clear the new extended stop seal. European inspections of modified shafts have found no cracking after 6,500 to 15,000 hours of pump run time. The Unit 2 and Unit 3 shafts will be removed for modification during the first refueling outages, early 1988 for Unit 2 and early 1989 for Unit 3. Following the inspection of Unit 2 shafts an analysis of the results with recommendations concerning continued operation of Unit 3 is to be submitted to the staff.

Vibration Monitoring

The vibration monitoring systems at Palo Verde 1, 2, and 3 include motor accelerometers and X-Y Proximity probes. A third transducer probe for measuring phase

DRAFT



DRAFT

angle has been installed in Unit 3 RCPs, is to be installed in Unit 1 RCPs during the current outage, and is scheduled to be installed in Unit 2 during the first refueling outage (planned for February 1988). Advanced systems for vibration monitoring have been installed in Units 2 and 3 for evaluation.

As a result of the discussions in Europe and at the November 4, 1987 meeting the staff concluded that the effectiveness of the vibration monitoring program set forth in the October 25, 1987 Confirmatory Order should be enhanced by including a spectral analysis of the vibration data to provide earlier warning trends if a crack has started and is propagating. In letters dated November 5 and 12, 1987, the licensees have committed to further augment the reactor coolant pump monitoring program by including a spectral analysis of the data.

The Commission subsequently issued a modification to the Unit 2 confirmatory order of October 25, 1987 which requires the following:

- A. The licensees shall implement an augmented vibration monitoring program for each of the four reactor coolant pumps that includes the following elements:
1. Every four hours, monitor and record the vibration data on each of the four reactor coolant pumps.
 2. On a daily basis, perform an evaluation of the pump vibration data obtained in 1 above by using an appropriately qualified engineering individual.
 3. When any one vibration monitor on the reactor coolant pumps indicates a vibration level of 8 mils or greater, the Nuclear Regulatory Commission shall be notified within four hours via the Emergency Notification System. In addition, when the vibration on any pump exceeds 8 mils due to a shaft crack or unknown cause, within four hours the affected pump shall have its orbit and spectra continuously monitored and evaluated by an appropriately qualified individual.
 4. When any one vibration monitor on the reactor coolant pumps indicates a vibration level of 10 mils or greater, within one hour, initiate action to place the unit in at least HOT STANDBY within the next six hours, and at least COLD SHUTDOWN within the following 30 hours. In addition the affected pump shall be secured after entering Hot Standby (Mode 3).
 5. On a daily basis a spectrum analysis shall be performed on the reactor coolant pump shaft vibration data and shall be evaluated for trends by using an individual qualified in that technique. The evaluation shall consist of comparing the running speed (1xRPM) and twice running speed (2xRPM) spectral components to limits computed from the baseline vibration. The limits shall be based on the lowest of: (a) 1.6 times the baseline value; (b) the mean plus three standard deviations; (c) 2 mils for the 2xRPM component; or (d) 6 mils for the 1xRPM component. When the amplitude exceeds any limit, further

DRAFT



DRAFT

analysis shall be performed. This analysis shall consist of an inspection of the amplitude versus time plots for a steadily increasing trend, and a review of other plant data which might explain the change in amplitude. If it is confirmed that the trend is not caused by plant or pump conditions unrelated to a shaft crack, the trend shall be extrapolated manually and/or by computer to predict the time at which the vibration is expected to reach 10 mils. If the projected time for reaching 10 mils is one week or less, the Unit shall be brought to HOT STANDBY pursuant to item 4 above and the affected pump shall be secured. After reaching HOT STANDBY, the Unit shall proceed to COLD SHUTDOWN within the following 30 hours.

- B. The licensees, shall install modified reactor coolant pump shafts during the next refueling outage currently scheduled to start in February 1988 which include the modifications described in Figure DES-3 of the attachments to the licensees' November 5, 1987 letter.

CONCLUSION

Each unit at Palo Verde has an effective vibration monitoring program in place. Such monitoring programs will detect the occurrence of severe cracking on the pump shafts a week prior to its actual failure, which is adequate to provide timely warning for an orderly plant shutdown.

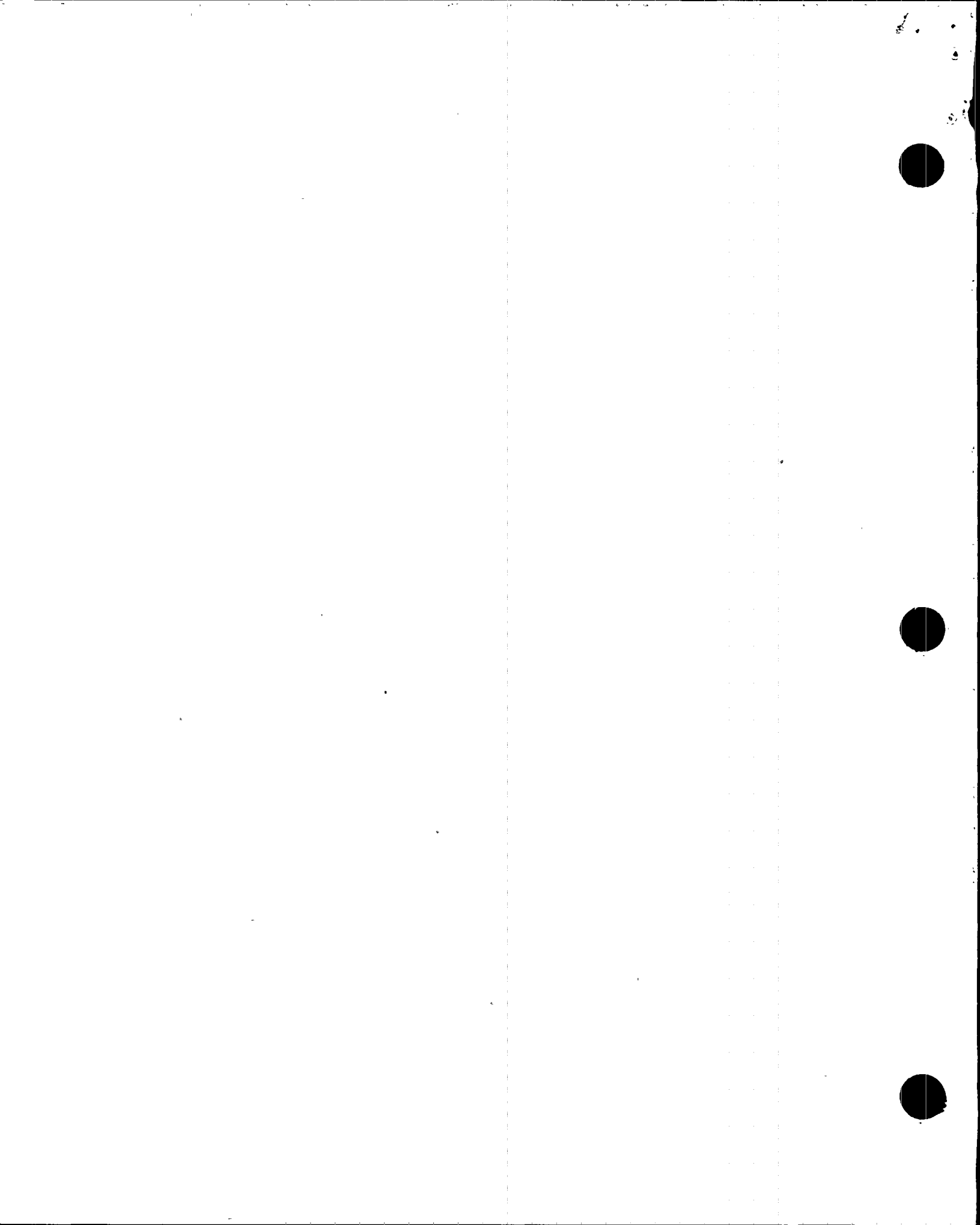
Key points from an operational history comparison of the three Palo Verde Units are:

1. Total projected pump operating hours for Unit 2 at refueling (15,800 hours) will be approximately 20% less than the actual Unit 1 pump hours (19,400 hours).
2. The Unit 2 pumps will have approximately 25% fewer starts and stops than the Unit 1 RCPs.
3. The Unit 2 pump operating hours at low temperatures (higher shaft stress) are on average 50% less than Unit 1.
4. The loss of seal injection events for Unit 2 pumps (2 occurrences) are less than the Unit 1 - 1B pump (13 occurrences).
5. Unit 3's operating history should be similar to Unit 2.

Due to these considerations the Unit 2 and Unit 3 RCP shafts could be expected to experience a lesser degree of shaft crack indications than the Unit 1 shafts.

For these reasons and because adequate shaft vibration monitoring capability and procedures are in place, the staff concludes that Unit 2 and Unit 3 can complete their first cycle of operation without undue risk to the public health and safety. For Unit 3 the staff will assess the results of the Unit 2 inspection and the accompanying analysis after the 1988 Unit 2 refueling outage to determine if there is need for revising the staff position on Unit 3.

DRAFT



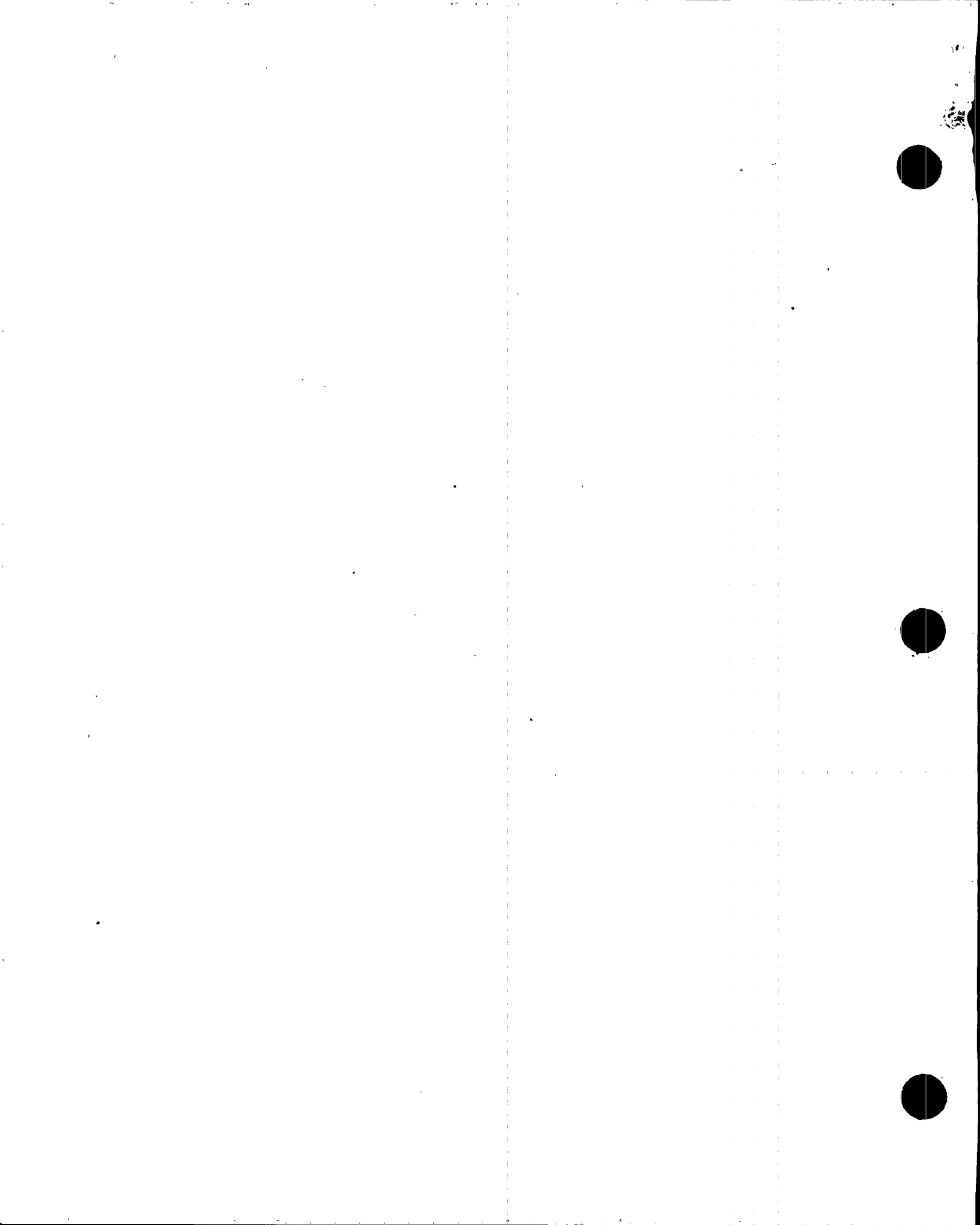
Summary of Region V Inspection of Requalification TrainingFindings from October 22-23, 1987 Inspection:

1. Exam was operationally oriented ~65% of questions were operational
2. ~15% of questions were open ended. e.g Describe, explain, list.
(Reduced from ~39% open end questions in prior year exams.)
3. Grading generally OK. Maybe too strict to key in response to RV prior criticism.
4. ~70% new questions (not from Palo Verde Exam. Bank). More operational; required more specific answers.
5. Exam and key changes. 3 questions removed (poor questions) key changes on a few questions. 4 more passed as result. Now 10 of 35 failed exam. 4 of 19 shift crew personnel failed; 6 of 16 non-shift crew personnel failed.
6. Overall results 9/2 and 9/23 exams.
24% (13 of 54*) failed.
17% (6 of 36) shift personnel failed.
37% (7 of 19) non-shift personnel failed.
*One person took both exams.
7. Interviews with personnel indicated that the non-shift personnel had prepared for exam mostly by self study; mostly reviewing past exams. from Palo Verde exam bank. The 9/2 and 9/23 exams were different from past exams requiring more procedural knowledge, tech. spec. bases and more precise (key words and phrases) answers. During interviews with operations management personnel that took the 9/23 examination, they stated that they had not provided input to the training department on the needs of the operations organization.
8. There appears to be a mismatch between what was included in the requal. training and how the material was covered on the examination. On several questions the operators scored very low and the lead instructor stated that the exam question approached the area differently than it was covered during the training lesson.
9. The 9/23 exam was not reviewed by the training analysis until after it was administered. This allowed several poor questions to be used that would have been taken out or improved upon review.



Summary

- i. An excessive number of the plant operators failed the facility administered requal. exam. Weaknesses in Palo Verde Requal. Program were identified as follows
 - a. Mismatch between training and exam. Exams upgraded but training has not been upgraded.
 - b. Non-shift personnel not receiving structured training. Mostly training has been self study from old exams.
 - c. Exams have not been reviewed by training analyst nor Operations staff.
 - d. Examination key had not been corrected to include all correct answers and only answers on the key were accepted by the graders.
 - e. Exam questions for most of the exam (sections 2, 3, 4, 6, 7, 8) were not derived from the job task analysis.
2. Improvement in the Palo Verde Requal. Program were identified as follows:
 - a. Exam improvements.
 - . Questions more operational on 9/2/87 and 9/23/87 exams as compared to prior year exam. (65% vs 38%)
 - . Fewer open ended questions were used on 9/2/87 and 9/23/87 exams compared to prior year exams (15% vs 39%)
 - . Grading to key was much improved over prior year exams, but key must be further improved to include all correct answers (see above)
 - b. No duplication between 9/2/87 and 9/23/87 exams. Much improved over approximately 30% duplication between exams used for 1986.
3. Short term corrective actions taken or planned.
 - a. All personnel that failed the 9/2 or 9/23 exam except one has received retraining on the area that they performed poorly on the exam and have been re-examined. All but one of the those re-examined passed the exam. All shift personnel passed the re-examination and have been assigned licensed duties. The remaining two will not be assigned licensed duties until they have received additional training and have passed an exam.



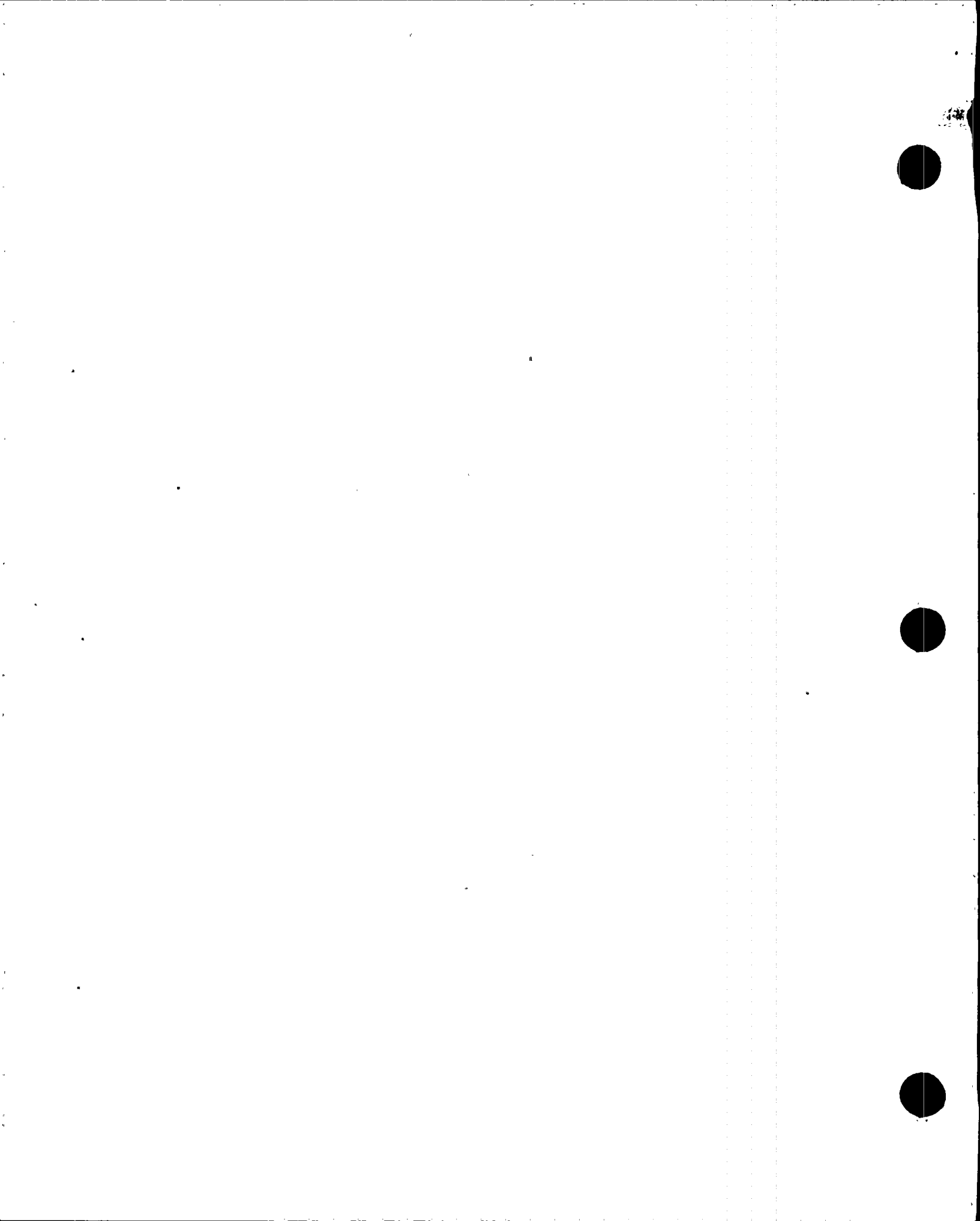
- b. The results of the 9/2 and 9/23 exam will be analyzed for areas that need additional training based on the results of those that took the exam. All areas identified will be included in the next two 6 week training cycles. All licensed personnel at Palo Verde will be trained and examined in these identified areas.
- c. Overlap between examinations used during each requal. cycle will be 10% or less.

4. Long term corrective actions planned.

- a. The training department with active participation by operation's department will do the job task analysis again and establish new learning objects as necessary. The lesson plans will be revised to be consistent with the new learning objectives.
- b. The exam question bank will be expanded and all questions will be derived from learning objectives. Also all questions will be reviewed by a training analyst and a SRO from the Operations Department staff.
- c. Exam question quality will be improved by maximizing the use of operational questions and minimizing the use of open ended questions.
- d. The simulator scenarios will be derived from the learning objectives and reviewed by a SRO from the Operation Department prior to use.

5. NRC planned actions.

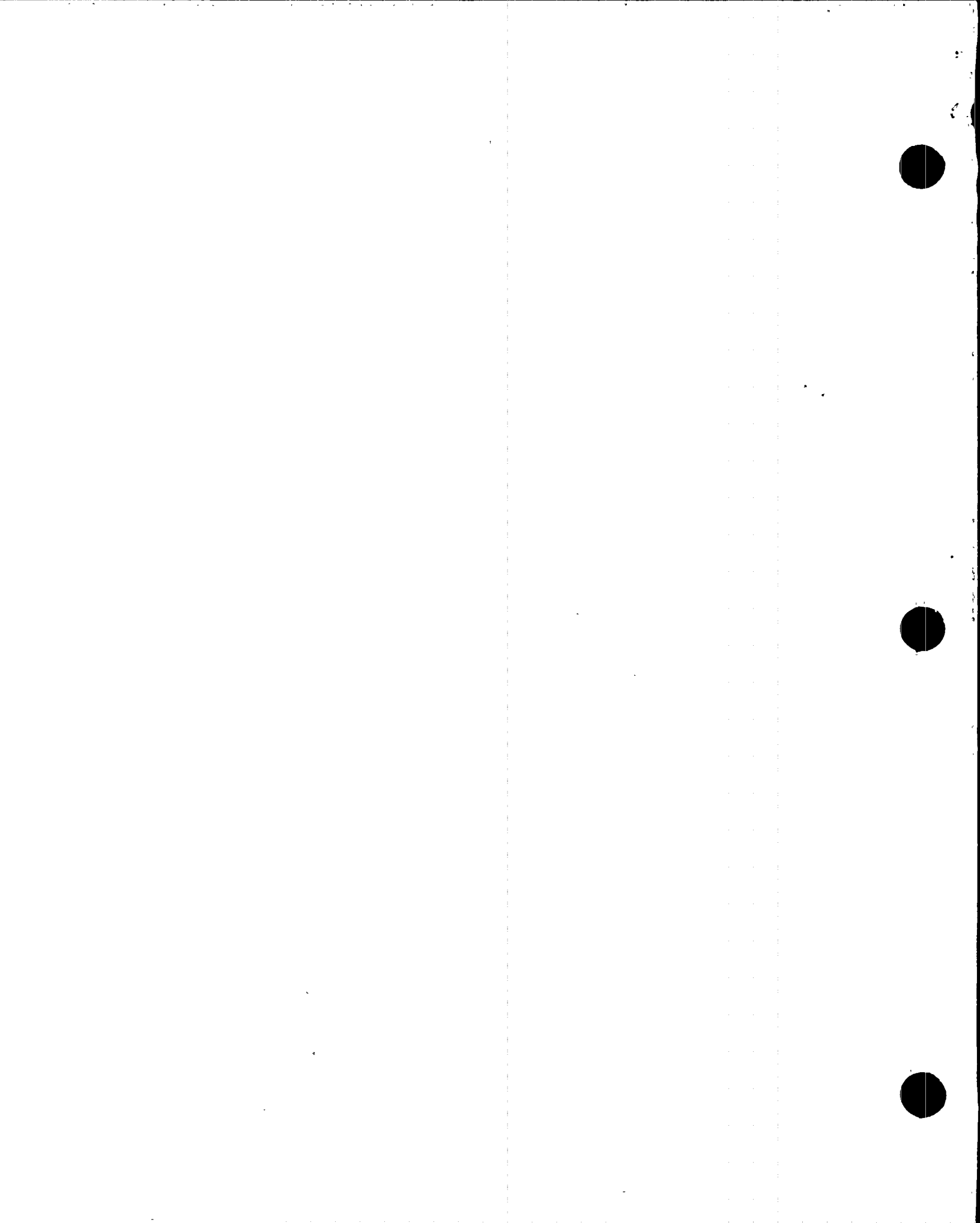
- a. Region V plans to review the areas that are identified by the Palo Verde training staff for retraining during the next two 6 week training cycles to monitor completeness of short term corrective actions.
- b. Region V plans to conduct a requalification examination at Palo Verde after the complete of their long term improvement. This requalification exam will be modeled after the new program being developed by NRC at H. B. Robinson. Palo Verde management advised that they plan to have their long term improvements complete by June 1988. Therefore, Region V plans to administer the requalification exam in June 1988.



PALO VERDE REQUAL. PROGRAM

Chronology

- January 27, 1987 NRC Administered requal. exam. SRO written exam not used for evaluation of requal. program due to duplication of questions from previous exam.
- ~ May 1987 Parallel graded 14 written exams given to SRO's during period August 22, 1986 through September 25, 1986 - 4 of 14 failed.
- June 26, 1987 Letter to Palo Verde (Pate to Van Brunt) Requal. program determined to be marginal.
- SRO Written - 4 of 14 failed
SRO Oral/Simulator - 1 of 14 failed
RO Oral/Simulator - 1 of 10 failed
<80% (18 of 24) passed
Grading differed by >10% per section
- October 15, 1987 Letter to Palo Verde (Pate to Van Brunt) Requal. program determined to be satisfactory. Parallel graded September 2, 1987. Facility exam 11 of 12 passed. <80% passed (NRC - Palo Verde 100% agree) Grading difference <10% per section
- ~ October 19, 1987 NRC advised that 14 of 35 failed the facility administered Requal. Exam of September 23, 1987.
- October 22-23, 1987 NRC Review of September 23, 1987 Requal. Exam.

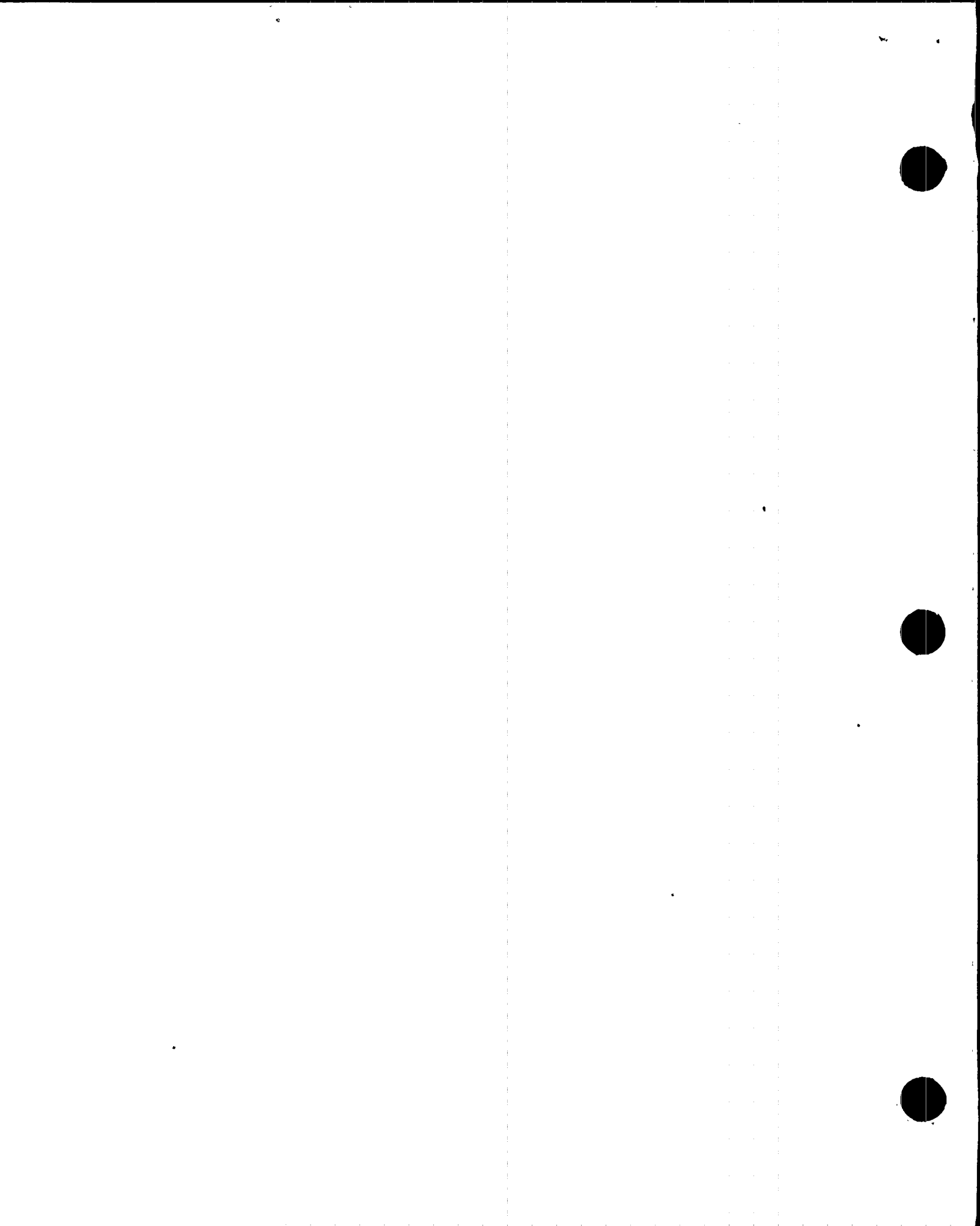


BRIEFING PACKAGE

PALO VERDE UNIT 3

FULL POWER LICENSE

NOVEMBER 1987



BRIEFING OUTLINE

LICENSEE/PLANT BACKGROUND

PLANT DESIGN

SITE CHARACTERISTICS

MILESTONE DATES

OPERATING EXPERIENCE ON UNITS 1 & 2

NEW PLANT EXPERIENCE MEETING

STEAM GENERATOR TUBE WEAR

DIESEL GENERATOR ISSUES

RCP SHAFT CRACKS

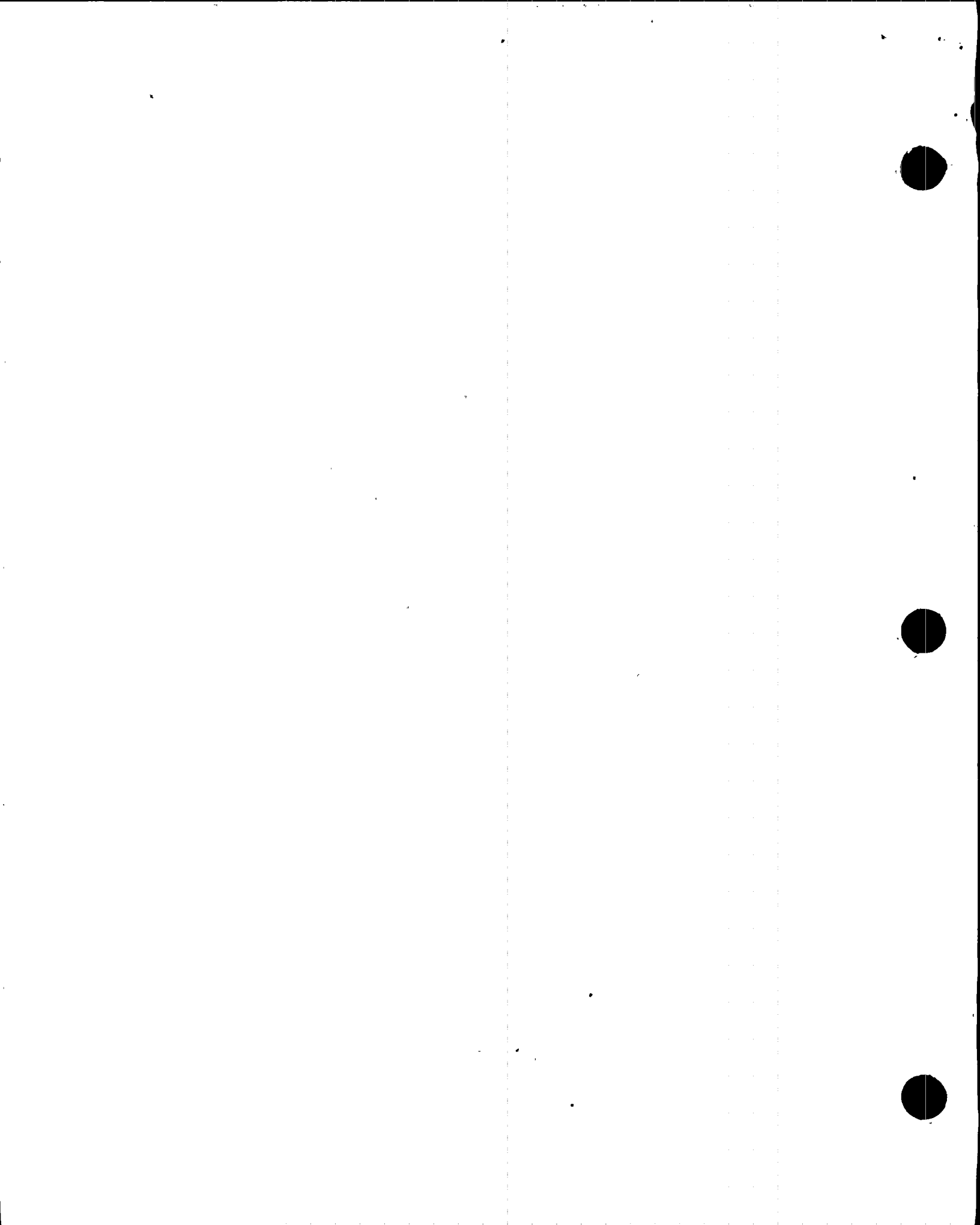
2.206 PETITIONS

INSPECTION PROGRAM

SALP/SALP PERSPECTIVES

ALLEGATIONS/INVESTIGATIONS

CONCLUSION



BACKGROUND

• OWNERS

ARIZONA PUBLIC SERVICE COMPANY	29.1%
SALT RIVER PROJECT	17.49%
LOS ANGELES DEPARTMENT OF WATER & POWER	5.7%
SOUTHERN CALIFORNIA EDISON COMPANY	15.8%
EL PASO ELECTRIC COMPANY	15.8%
PUBLIC SERVICE COMPANY OF NEW MEXICO	10.2%
SOUTHERN CALIFORNIA PUBLIC POWER AUTHORITY	5.91%

• OPERATOR

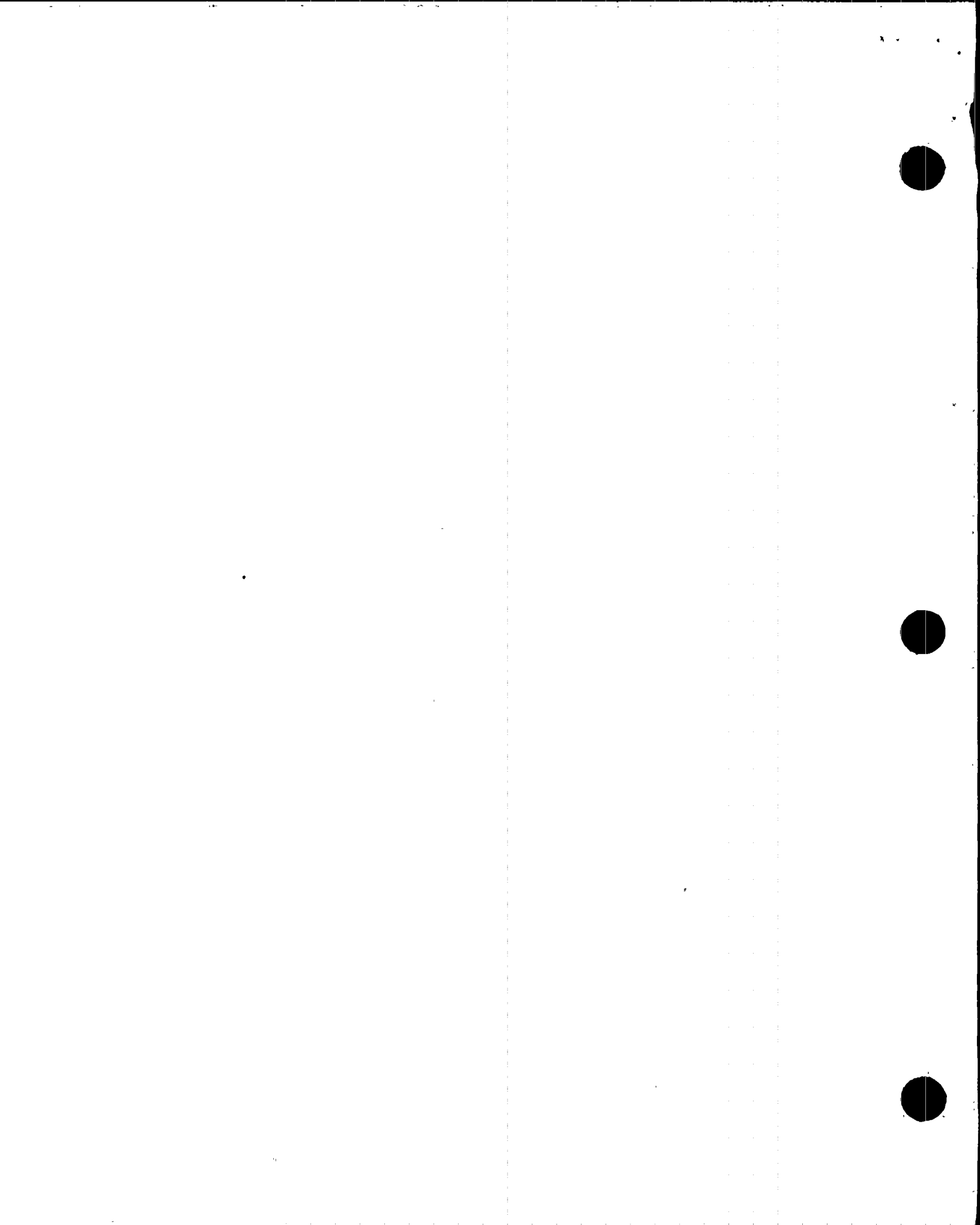
-ARIZONA PUBLIC SERVICE COMPANY

• EXPERIENCE

- CONSTRUCTION & OPERATION OF PALO VERDE UNIT 1
FULL POWER LICENSE JUNE 1985
- CONSTRUCTION & OPERATION OF PALO VERDE UNIT 2
FULL POWER LICENSE APRIL 1986

• NO OUTSTANDING HEARING ISSUES

- HEARING COMPLETE
- FINAL DECISION FEBRUARY 1983
- REOPENED HEARING ON SALT DEPOSITION DISMISSED
JULY 1985 BASED ON SETTLEMENT



PLANT DESIGN

- GENERAL

- THIRD IDENTICAL UNIT
- CE SYSTEM 80 PWR – 2 LOOP
- GE TURBINE
- ENGINEER AND CONSTRUCTOR: BECHTEL

- NSSS CHARACTERISTICS

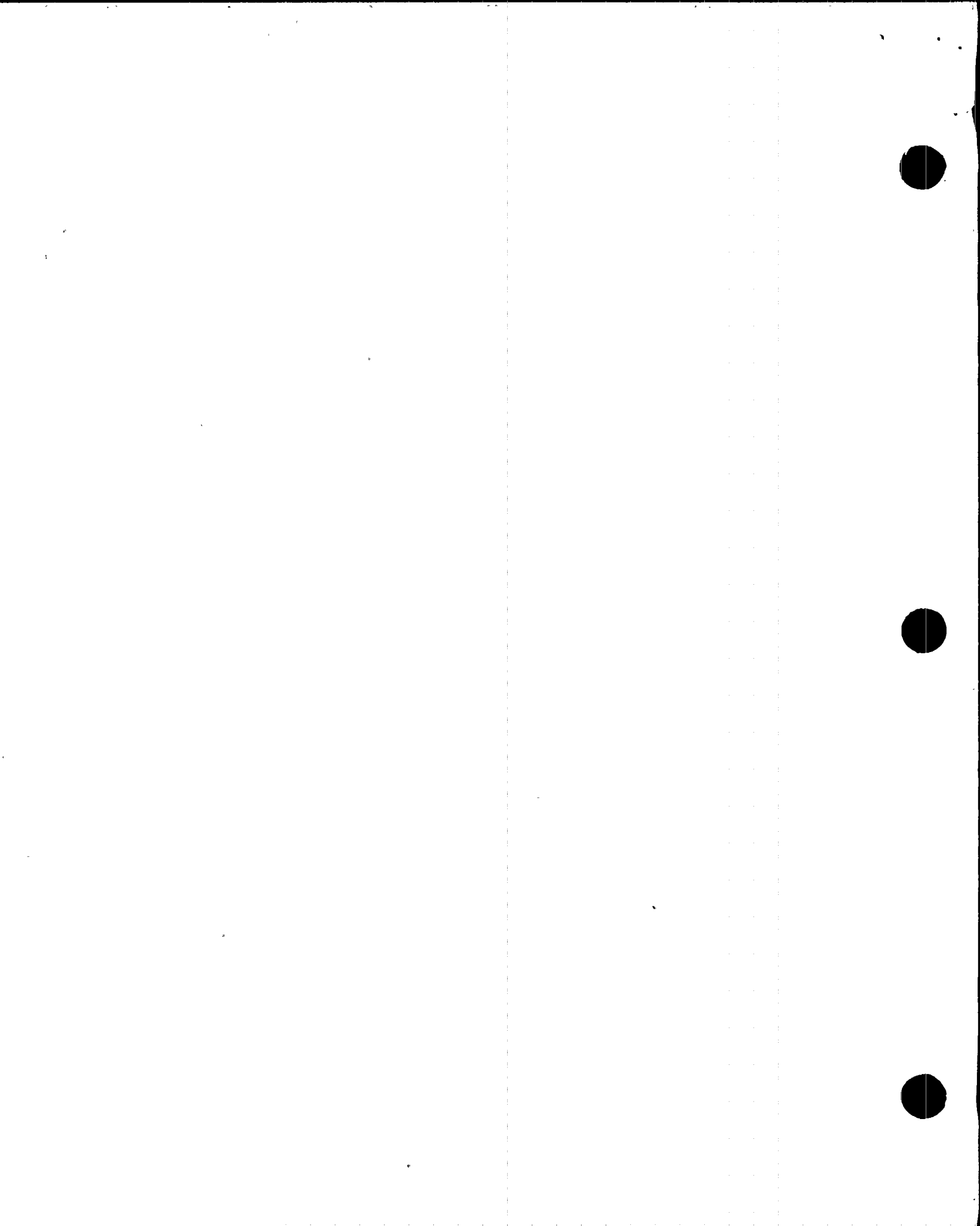
- RATED POWER 3800 MWT, 1300 MWE

- CONTAINMENT

- PRESTRESSED, POST-TENSIONED CONCRETE

- UNIQUE DESIGN FEATURES

- COOLING: MECHANICAL DRAFT TOWERS
USING TREATED EFFLUENT
FROM PHOENIX
- RADWASTE: ZERO RELEASE FACILITY



SITE CHARACTERISTICS

◦ SITE

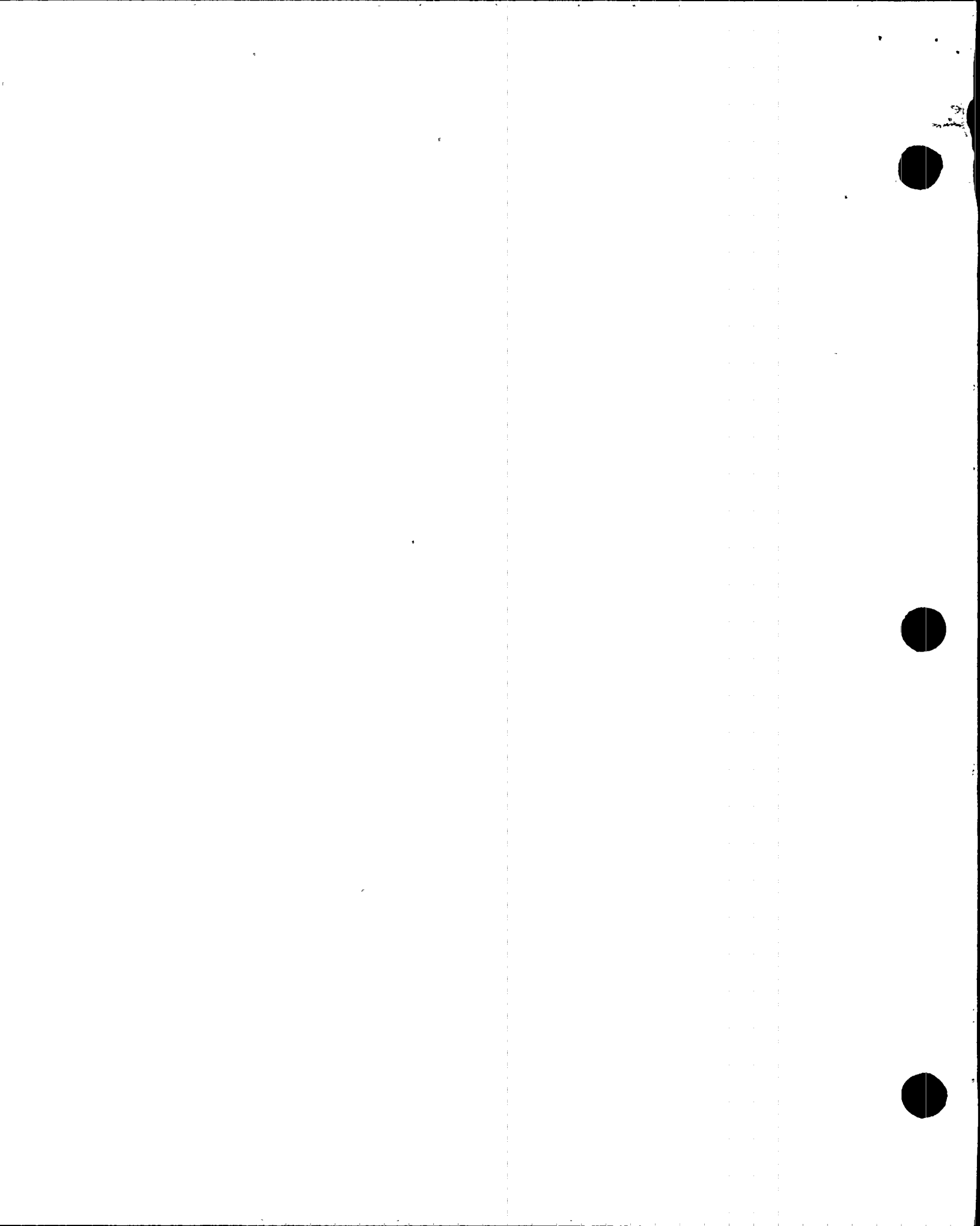
- LOCATED IN MARICOPA COUNTY, ARIZONA
- 50 MILES WEST OF PHOENIX

◦ SPARSELY POPULATED

- NEAREST TOWN - BUCKEYE
(16 MILES, POPULATION 3000)

◦ OFFSITE EMERGENCY PLANNING

- FEMA FINAL FINDINGS ON OFFSITE PLANS
SEPTEMBER 1985
(OVERALL PLANS ARE ADEQUATE)
- LAST EMERGENCY EXERCISE - OCTOBER 1986
NO DEFICIENCIES IDENTIFIED



MILESTONE DATES

● PALO VERDE UNIT 1

- RECEIVED LOW POWER LICENSE - DECEMBER 31, 1984
- COMPLETED FUEL LOAD - JANUARY 11, 1985
- INITIAL CRITICALITY - MAY 25, 1985
- RECEIVED FULL POWER LICENSE - JUNE 1, 1985
- DECLARED COMMERCIAL OPERATION - FEBRUARY 13, 1986

● PALO VERDE UNIT 2

- RECEIVED LOW POWER LICENSE - DECEMBER 9, 1985
- COMPLETED FUEL LOAD - DECEMBER 16, 1985
- INITIAL CRITICALITY - APRIL 18, 1986
- RECEIVED FULL POWER LICENSE - APRIL 14, 1986
- DECLARED COMMERCIAL OPERATION - SEPTEMBER 22, 1986

● PALO VERDE UNIT 3

- RECEIVED LOW POWER LICENSE - MARCH 25, 1987
- COMPLETED FUEL LOAD - APRIL 2, 1987
- INITIAL CRITICALITY - OCTOBER 24, 1987



OPERATIONAL EXPERIENCE
PALO VERDE UNITS 1 AND 2

- **FIRST OF A KIND DESIGN**

- **SMALL NUMBER OF DESIGN PROBLEMS ENCOUNTERED**
 - FIXES APPLIED TO ALL THREE UNITS

- **SEVERAL UNEXPECTED EVENTS OCCURRED**
 - OPERATORS RESPONDED WELL

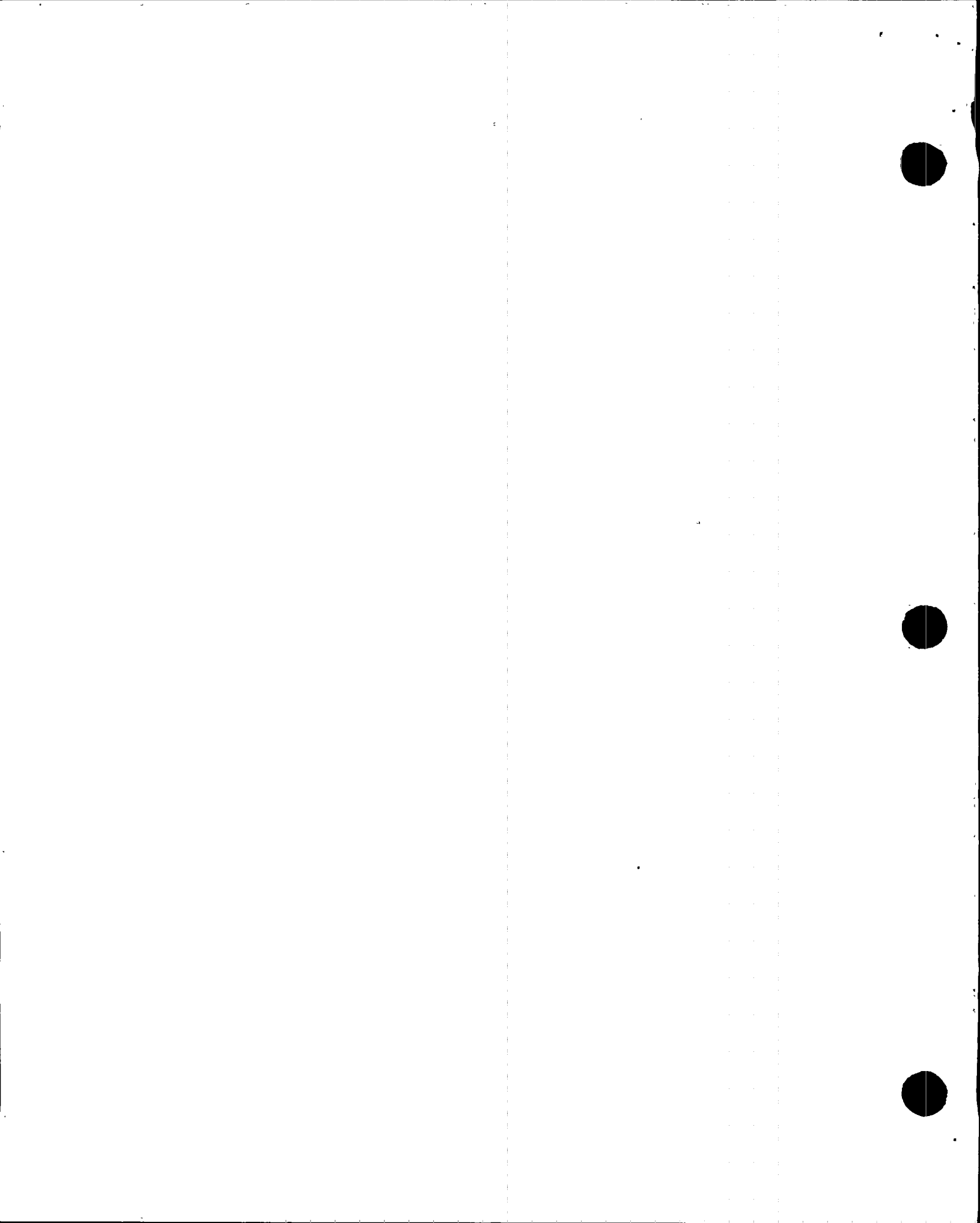
 - ESF ACTUATIONS REDUCED WITH EXPERIENCE

- **A NUMBER OF PERSONNEL ERRORS / MISSED SURVEILLANCES / SECURITY REPORTS OCCURRED DURING EARLY OPERATION**
 - PERSONNEL ERRORS REDUCED WITH EXPERIENCE

 - MISSED SURVEILLANCES CORRECTED BY MANAGEMENT ATTENTION TO DISCIPLINE

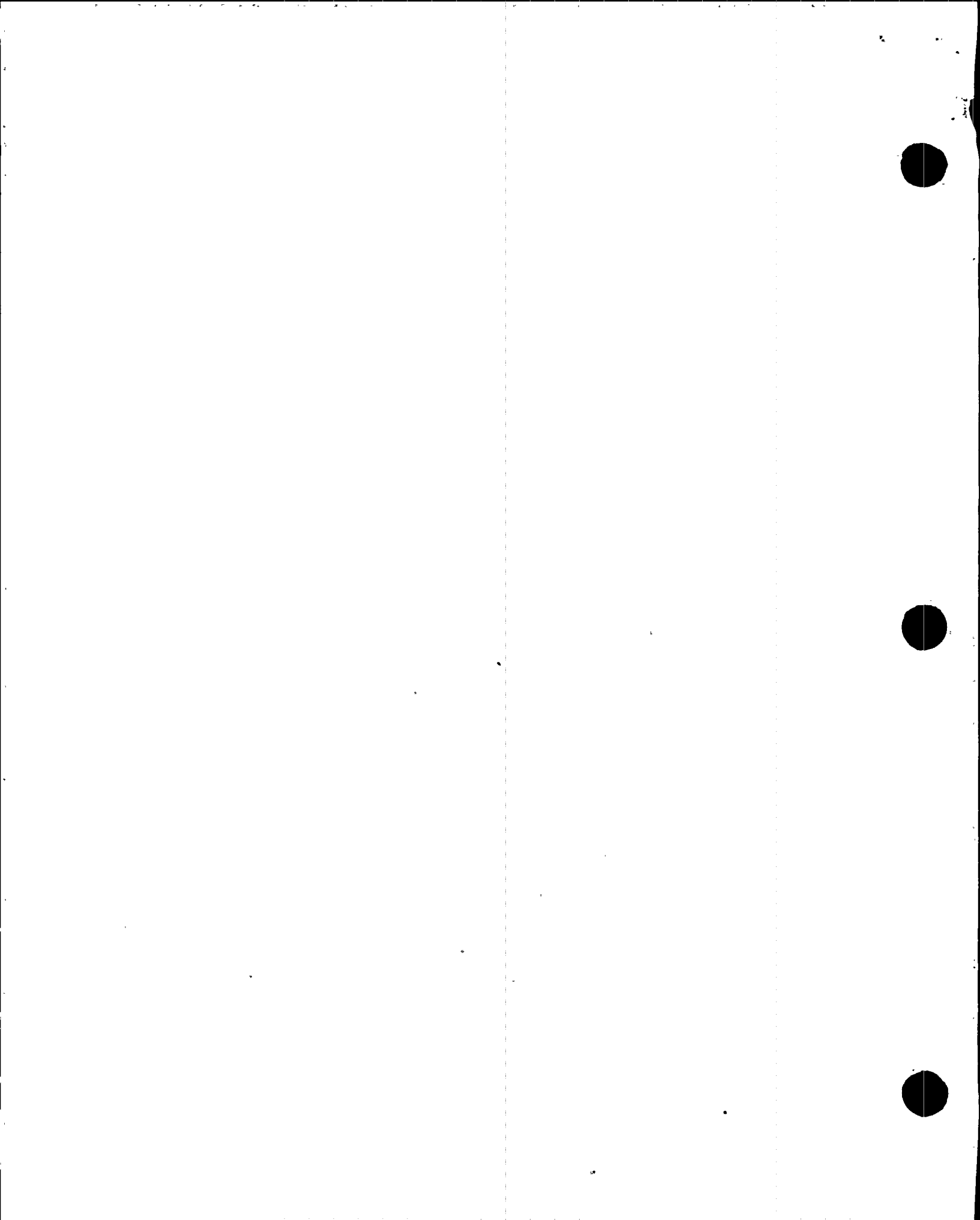
 - SECURITY REPORTS REDUCED BY MANAGEMENT ATTENTION

- **ROOT CAUSE ANALYSIS AND POST TRIP REVIEW PROCESS IMPROVED**



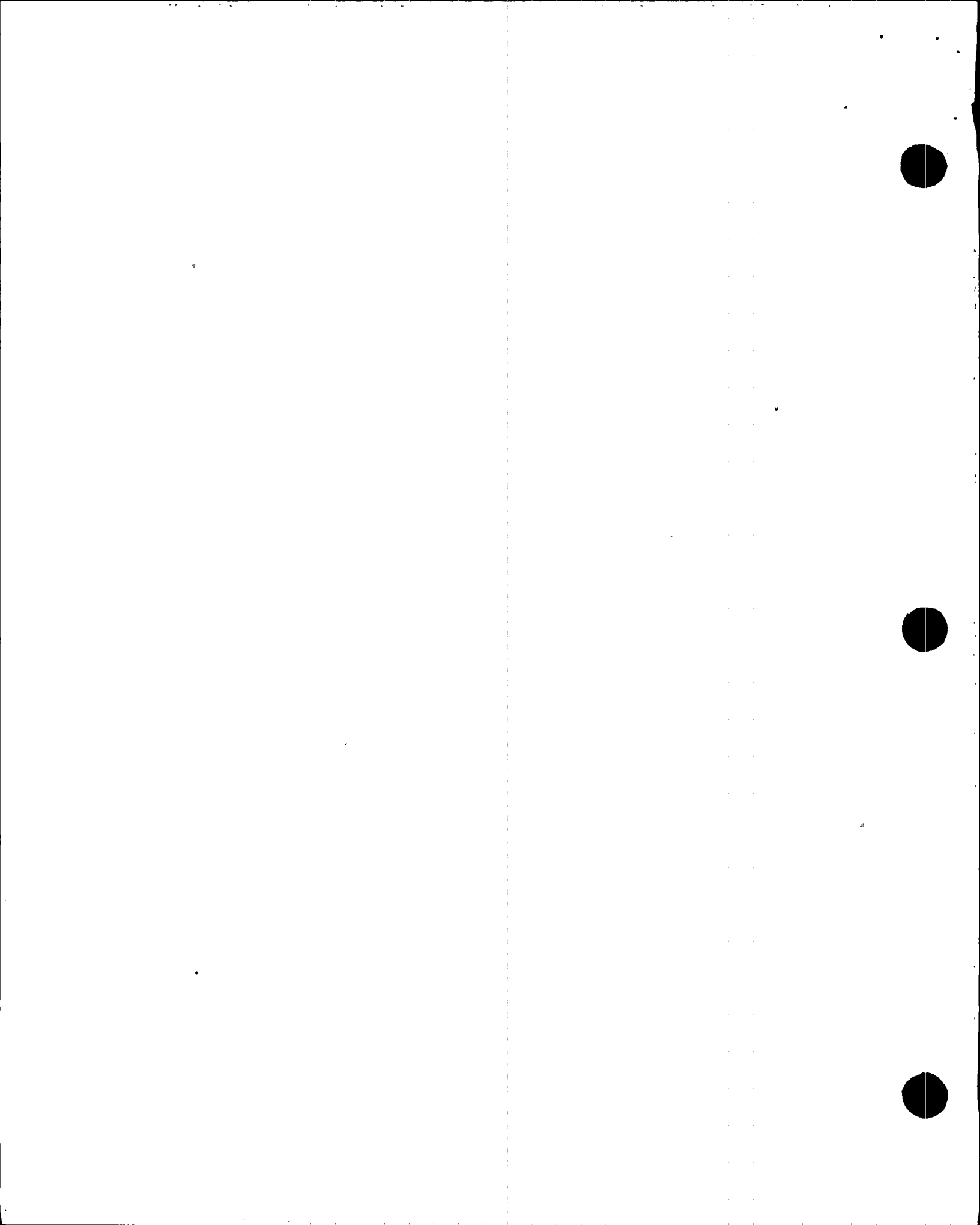
NUREG 1275
OPERATING EXPERIENCE
FEEDBACK REPORT—
NEW PLANTS

- MEETING HELD OCTOBER 2, 1987, TO ASSESS THE DEGREE TO WHICH THE LESSONS APPLY TO PALO VERDE UNIT 3.
- MANY OF THE RECOMMENDATIONS HAVE ALREADY BEEN INCORPORATED IN PROGRAMS AT PALO VERDE.
- EVENTS TRENDING AND PERFORMANCE INDICATORS SHOW THAT ACTIONS TAKEN BY LICENSEE MANAGEMENT HAVE BEEN EFFECTIVE.
- UNIT 3 IS IN STRONG POSITION FOR A NEW PLANT ENTERING POWER ASCENSION. EXPECTATIONS ARE HIGH.



STEAM GENERATOR TUBE WEAR

- TUBE LEAK IN NO. 1 STEAM GENERATOR AT PALO VERDE UNIT 1 ON JANUARY 18, 1987 AFTER LESS THAN ONE YEAR OF COMMERCIAL OPERATION
 - REVEALED LEAK LOCATION IN OUTER ROW NEAR ECONOMIZER
 - EDDY CURRENT TESTING OF OVER 3000 TUBES SHOWED 17 TUBES WITH INDICATIONS OF WALL THINNING
- STEAM GENERATOR NO. 2 IN UNIT 1 AND BOTH GENERATORS IN UNIT 2 ALSO EXAMINED; SIMILAR INDICATIONS FOUND
 - 9 TUBES IN S/G NO. 2 IN UNIT 1
 - 30 TUBES IN S/G NO. 1 IN UNIT 2
 - 21 TUBES IN S/G NO. 2 IN UNIT 2
- WEAR ATTRIBUTED TO FLOW INDUCED VIBRATION IN ECONOMIZER AREA
- ALL TUBES WITH INDICATIONS IN UNITS 1 AND 2 HAVE BEEN PLUGGED
- FOREIGN OBJECT DENTED 9 TUBES IN S/G NO. 1 OF UNIT 1 - 6 TUBES PLUGGED
- APS ACTION TAKEN ON S/Gs IN PALO VERDE UNIT 3, 60 TUBES PLUGGED IN EACH GENERATOR



PALO VERDE DIESEL GENERATOR ISSUES
(COOPER BESEMER ENGINE)

• **FAILURE OF UNIT 3 "B" DIESEL DURING TEST**
ON DECEMBER 23, 1986

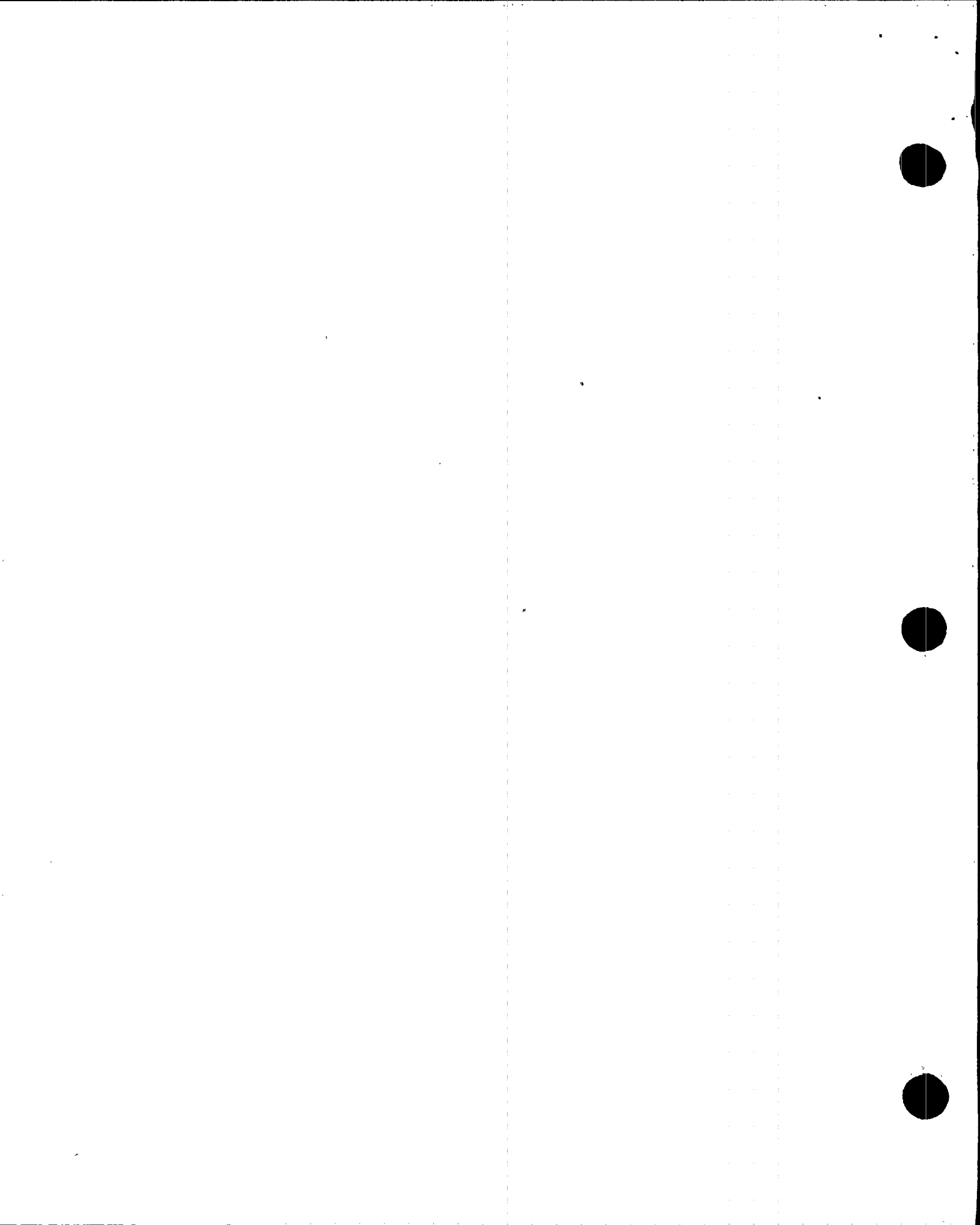
- EXTENSIVE DAMAGE OCCURRED
- ROOT CAUSE - FAILURE OF IRON PLATING USED TO REPAIR
OVERBORED ROD
- LICENSEE GRANTED SCHEDULAR EXEMPTION WITH LOW
POWER LICENSE IN MARCH 1987 PERMITTING FUEL LOAD
WITH ONE DIESEL GENERATOR OPERABLE
- REPAIR & RETESTING COMPLETE - DECLARED
OPERABLE SEPTEMBER 13, 1987

• **FIRE IN UNIT 2 "A" DIESEL DURING TEST**
ON FEBRUARY 8, 1987

- LIMITED DAMAGE OCCURRED
- ROOT CAUSE - IMPROPER INSTALLATION OF FUEL LINE
COMPRESSION FITTING
- ENGINE REPAIR COMPLETE

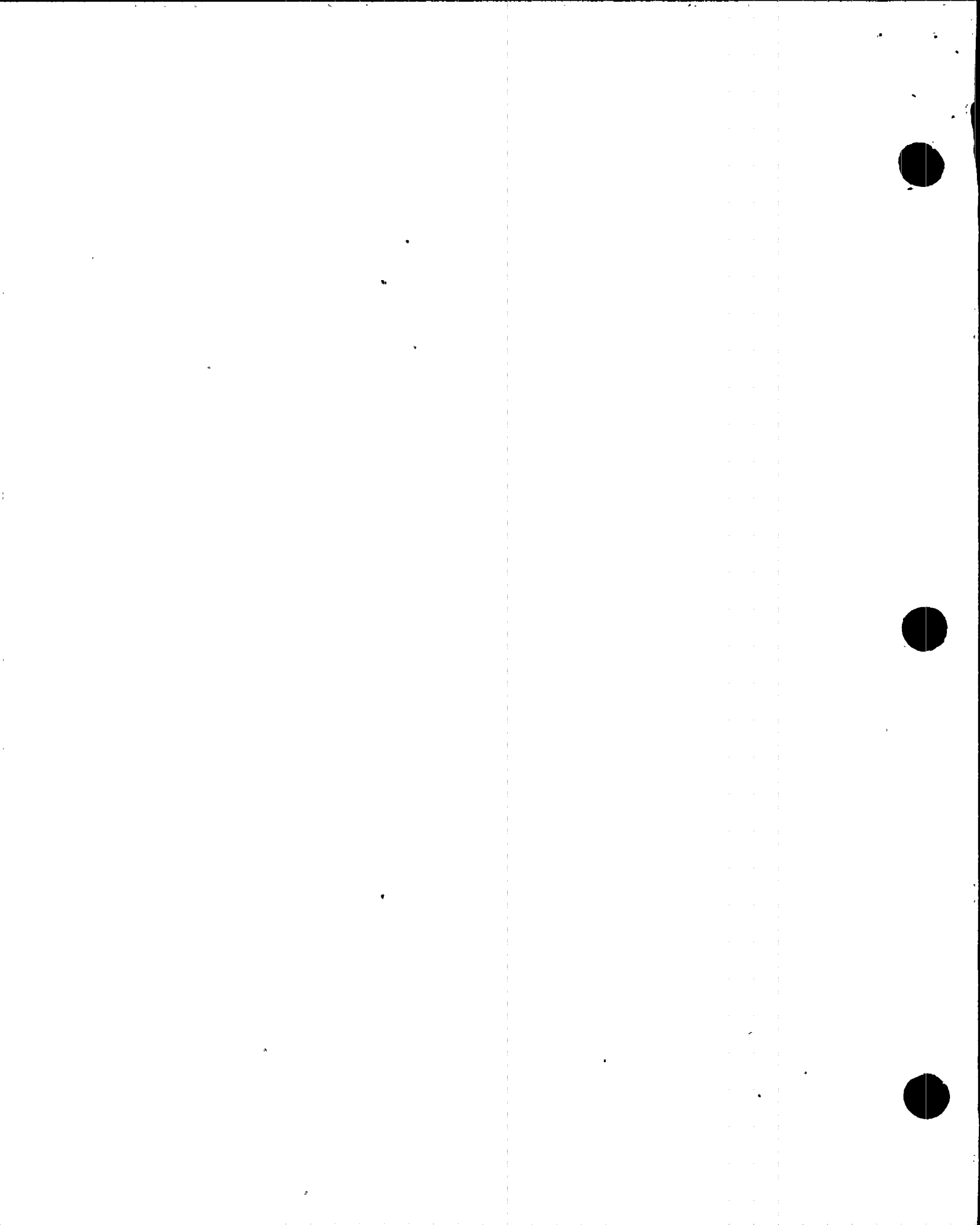
• **PERIODIC LEAKAGE FROM FUEL LINE FITTINGS**
IN SEVERAL DIESEL ENGINES

- MODIFICATION IN FITTING NUT REQUIRED
- FITTING NUT REPLACED ON ALL FUEL LINES
IN PALO VERDE ENGINES



RCP SHAFT CRACKING

- SHAFT CRACKS DISCOVERED IN AREA OF KEYWAYS ON UNIT 1 RCPs
- ACTIONS TAKEN
 - INSTALLED ADDITIONAL VIBRATION SENSOR ON UNIT 3 RCPs (ALSO TO DO UNITS 1 & 2)
 - MODIFIED SHAFTS BEING INSTALLED IN UNIT 1 (WILL MODIFY UNIT 2 & 3 SHAFTS 1ST REFUELING)
 - ENHANCED VIBRATION MONITORING PROGRAM
 - LICENSE CONDITIONS REQUIRE SHUTDOWN ON INCREASING PUMP VIBRATION/TREND
- OVERVIEW
 - CRACKS IN UNIT 3 SHOULD BE SMALLER THAN UNIT 1 (FEWER OPERATING HOURS)
 - VIBRATION MONITORING PROVIDES AMPLE WARNING OF CRACK GROWTH
 - NO SAFETY CONSEQUENCES TO SHAFT FAILURE
 - DATA ON UNITS 1 & 2 AVAILABLE FOR MID-CYCLE REASSESSMENT OF UNIT 3



2.206 PETITIONS ON PALO VERDE

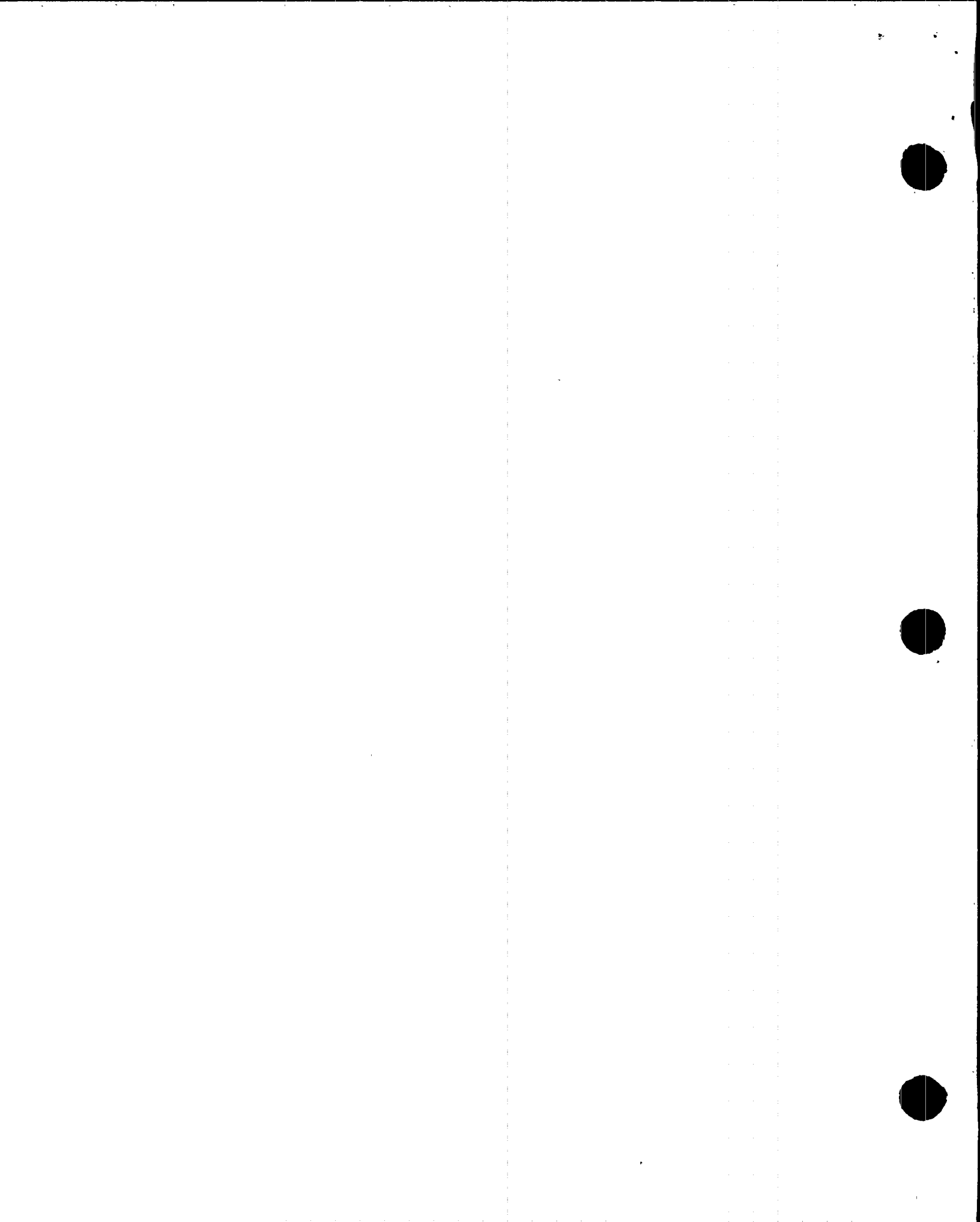
- JULY 16, 1986 PETITION FROM CREE
 - ALLEGES LICENSEES VIOLATED 10 CFR 50.7 BY REQUIRING POLYGRAPH TESTING TO DISCOURAGE REPORTING UNSAFE CONDITIONS

 - BEING EVALUATED BY OGC FOR FURTHER ACTION

- APRIL 27, 1987 PETITION FROM CREE
 - ALLEGES DISABLING OF SAFETY SYSTEM WAS UNAUTHORIZED AND MANAGEMENT RESPONSE INADEQUATE TO PREVENT RECURRENCE. BASED ON NRC INSPECTION REPORT.

 - DIRECTOR'S DECISION IN CONCURRENCE CHAIN.

- NO ISSUES IDENTIFIED IN EITHER PETITION IMPACTING PALO VERDE UNIT 3 LICENSING



PALO VERDE UNIT 3

INSPECTION PROGRAM

- CONSTRUCTION PROGRAM MODULES

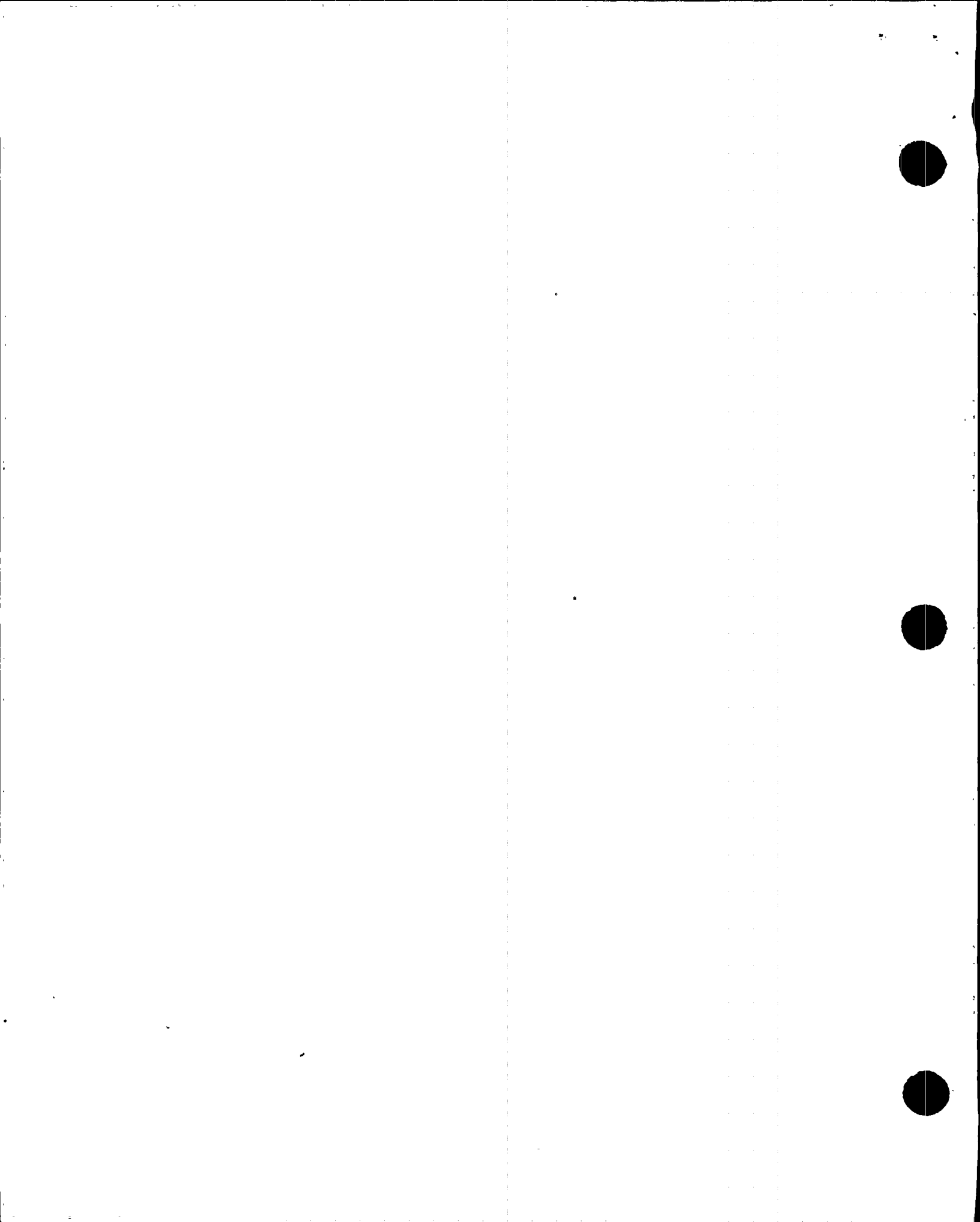
- ALL PRIORITY 1 MODULES COMPLETE
- CONSTRUCTION ASSESSMENT TEAM INSPECTION JAN/FEB 1986. HARDWARE AND DOCUMENTATION FOR CONSTRUCTION ACTIVITIES WERE GENERALLY FOUND TO BE IN ACCORDANCE WITH REQUIREMENTS AND LICENSEE COMMITMENTS. HOWEVER, WEAKNESSES WERE IDENTIFIED IN THE AREAS OF MASONRY WALLS, MOUNTING OF ELECTRICAL COMPONENTS, VENDOR SUPPLIED EQUIPMENT, WITH SUBSEQUENT ENFORCEMENT ACTION.

- PREOPERATIONAL TESTING AND OPERATIONAL READINESS MODULES

- COMPLETE

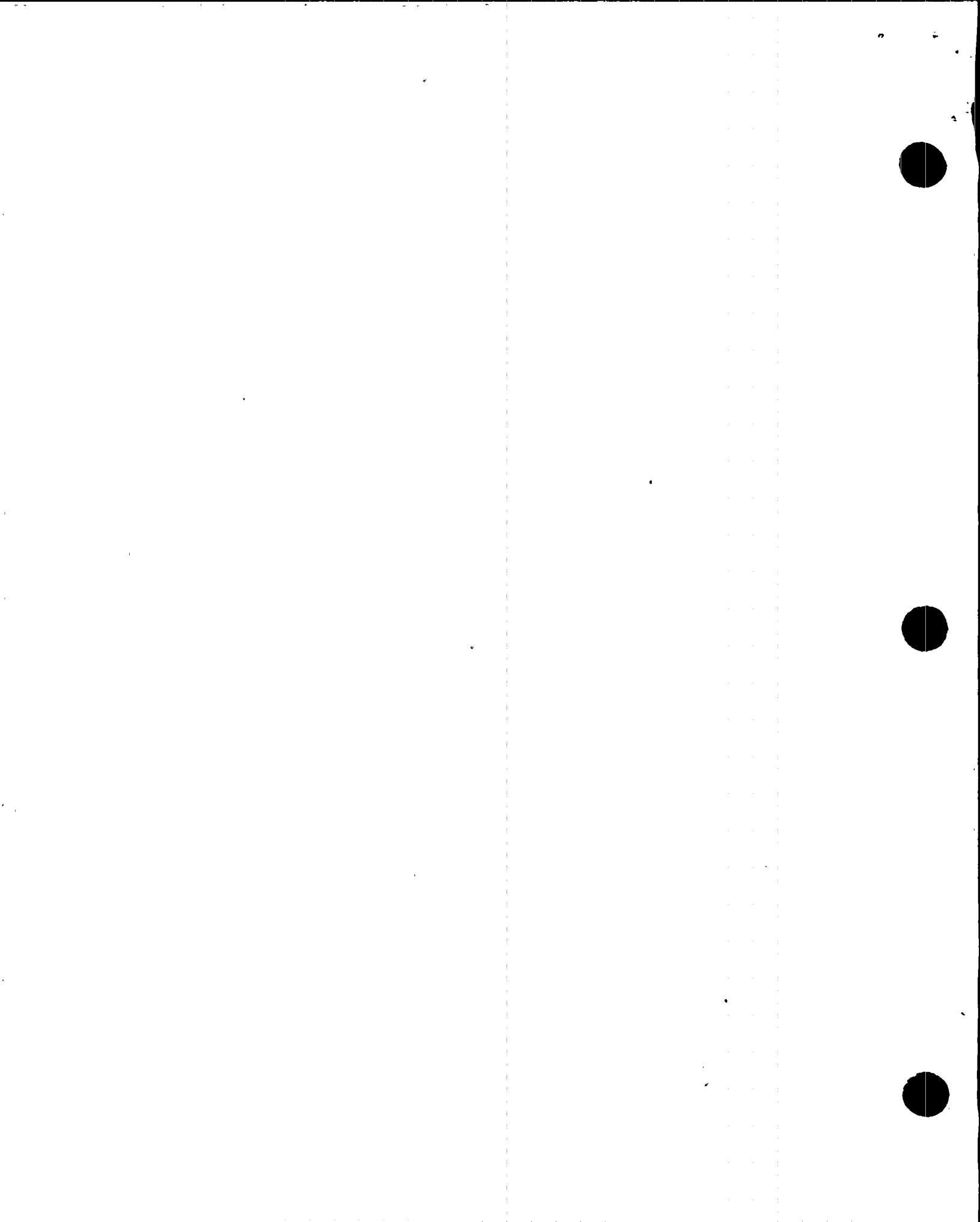
- STARTUP TESTING PROGRAM MODULES

- THIS INSPECTION PROGRAM IS CURRENT WITH THE LICENSEE'S STARTUP TEST PROGRAM.
- INSPECTION OF POWER ASCENSION TESTING SCHEDULED FOR DECEMBER 10-18, 1987.



SALP PERSPECTIVES FROM JANUARY 1987

- FIVE LEVEL 1 RATINGS, ONE LEVEL 3 IN SECURITY, AND THIRTEEN LEVEL 2 RATINGS
- STRENGTHS
 - MANAGEMENT ACTIVELY INVOLVED IN ONSITE ACTIVITIES
 - INSTRUMENTATION
 - FIRE PROTECTION PROGRAM
 - PREOPERATIONAL TESTING PROGRAM
- WEAKNESSES
 - SECURITY PROGRAM
 - QUALITY RELATED ACTIVITIES
 - MAINTENANCE BACKLOG
 - PERSONNEL ERRORS & MISSED SURVEILLANCES
 - LICENSING ACTIVITIES
- OVERALL PERFORMANCE WAS SATISFACTORY
- RECENT IMPROVEMENTS NOTED: E.G., IN SECURITY PROGRAM, LICENSING ACTIVITIES, & PERSONNEL ERRORS



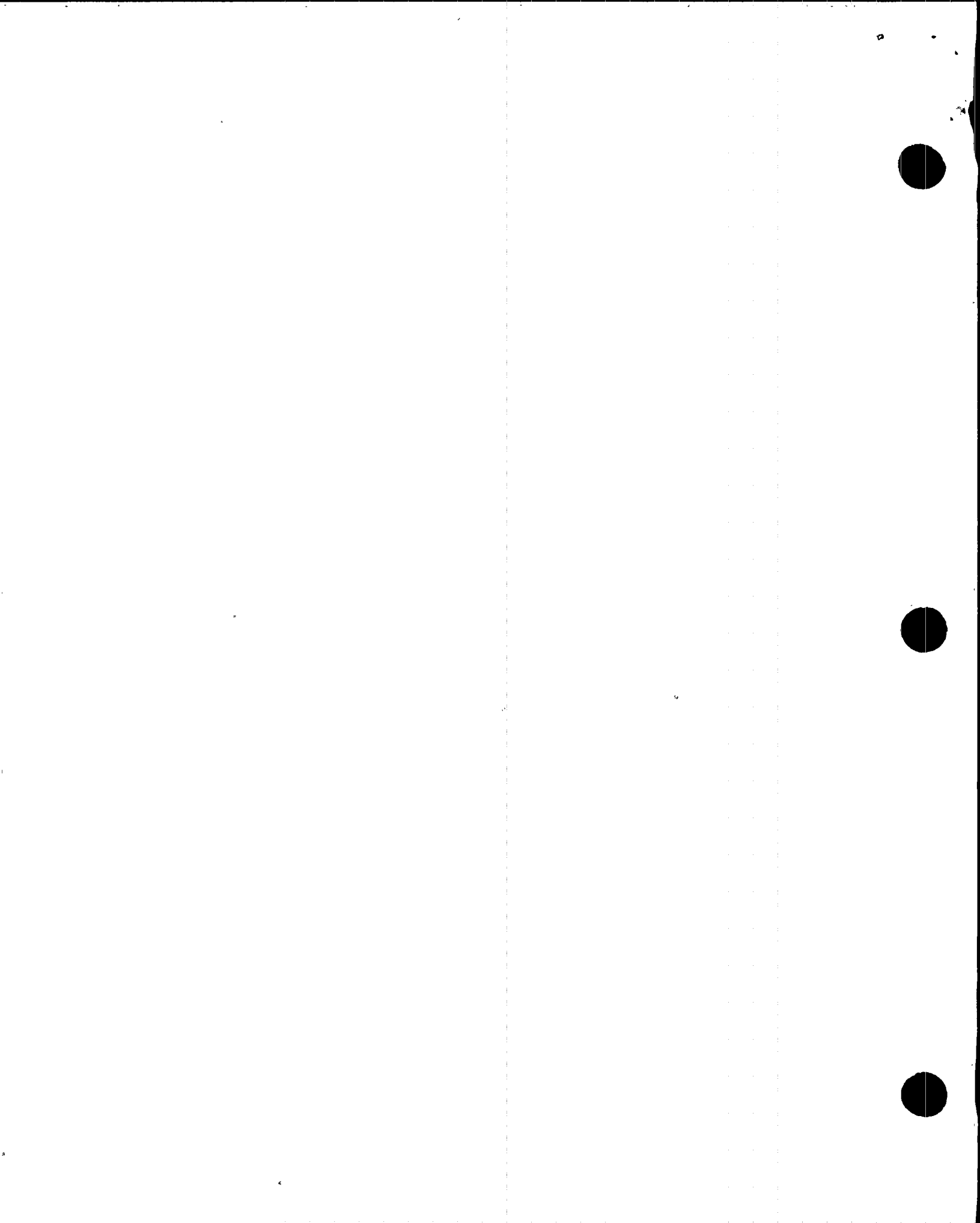
ALLEGATIONS/INVESTIGATIONS

- IN GENERAL, ALLEGATIONS RECEIVED FOR PALO VERDE HAVE APPLIED TO ALL THREE UNITS

- A NUMBER HAVE BEEN RECEIVED DURING THE PAST SEVERAL YEARS

- MOST HAVE BEEN RESOLVED

- A FEW ARE STILL OPEN
 - NONE ARE OF SUFFICIENT SAFETY IMPORTANCE TO PRECLUDE LICENSING



CONCLUSION

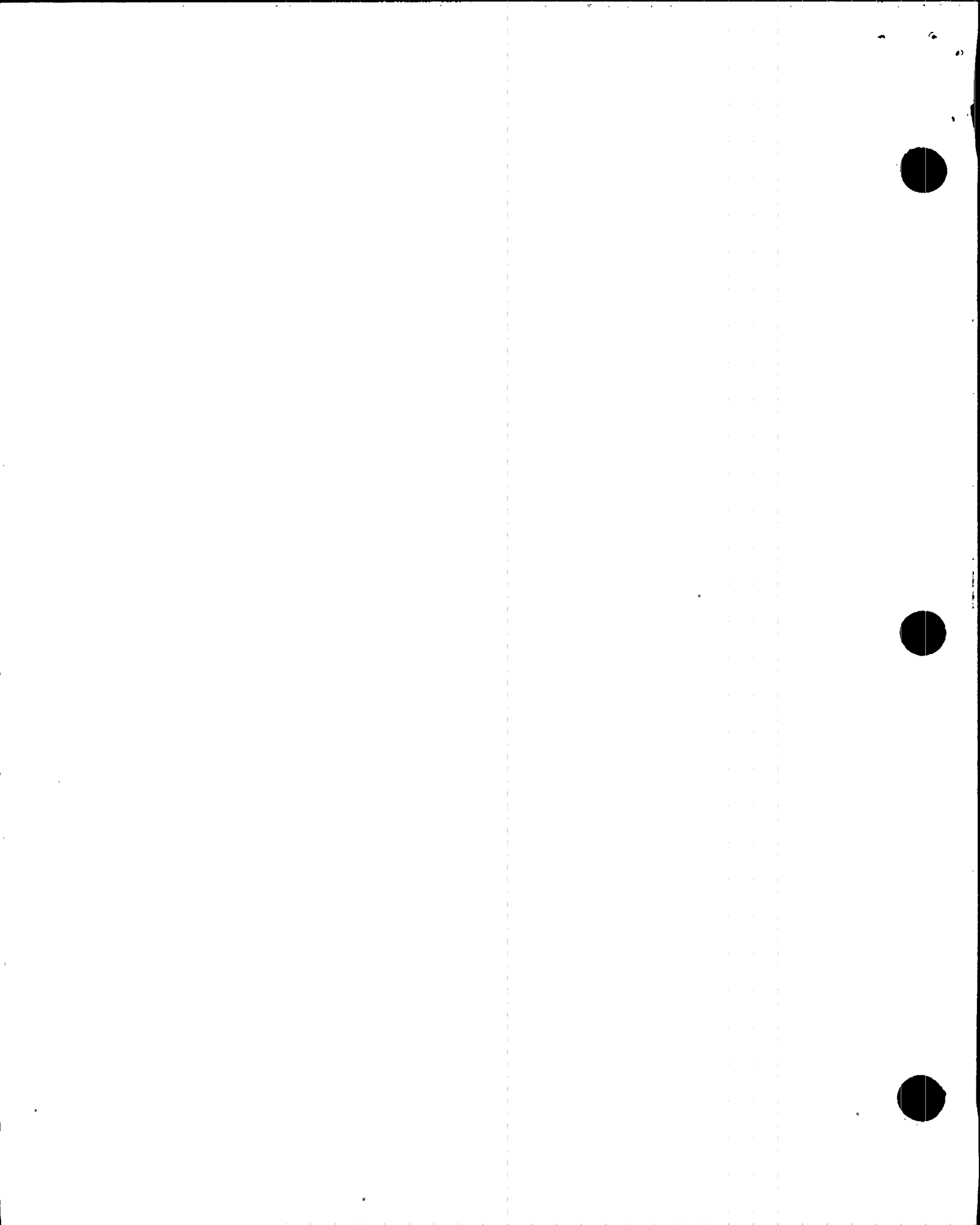
LICENSEES MEET

ALL REQUIREMENTS

FOR

FULL POWER

AUTHORIZATION



DRAFT

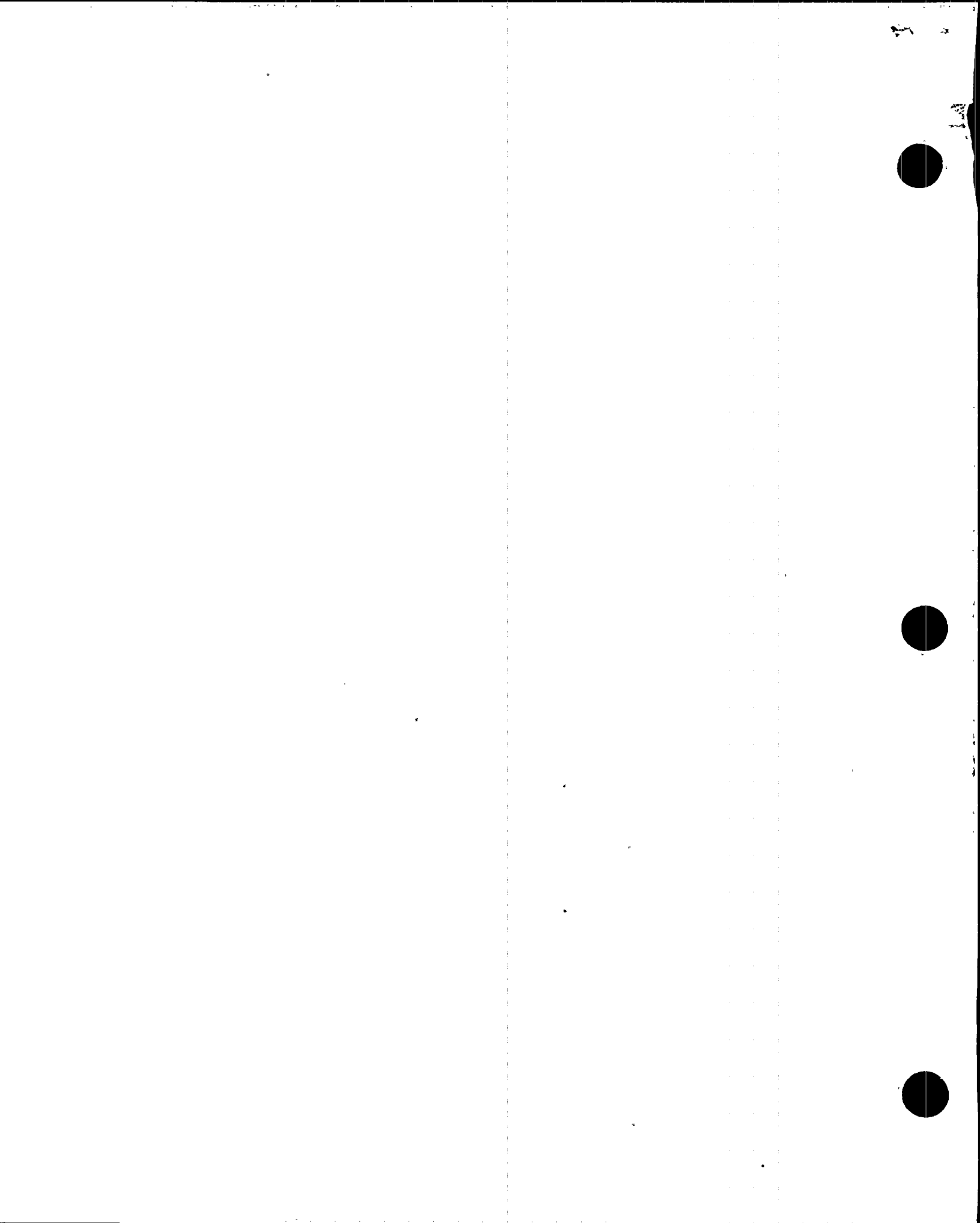
ATTACHMENT 1

PALO VERDE NUCLEAR GENERATING STATION, UNIT 3
OPERATING LICENSE NPF-74

This attachment identifies items that must be completed to the NRC staff's satisfaction in accordance with the schedule identified below.

1. Prior to entering Mode 1 for the first time, APS shall:
 - a. Have completed a review of the surveillance procedures applicable to the change of mode and determined that the procedures demonstrate the operability of the required systems with the respect to all acceptance criteria defined in the Technical Specifications.
 - b. Have dispatched written notification to the NRC Regional Administrator, Region V, that the action defined in (a), above, has been completed for Mode 1.
2. The post accident sampling system shall be operable prior to exceeding 5% power.
3. APS shall implement an augmented vibration monitoring program for each of the four reactor coolant pumps that includes the following elements:
 - a. Every four hours, monitor and record vibration data on each of the four reactor coolant pumps,
 - b. On a daily basis, perform an evaluation of the pump vibration data obtained in a above, by using an appropriately qualified engineering individual,
 - c. When any one vibration monitor on the reactor coolant pumps indicates a vibration level of 8 mils or greater, the Nuclear Regulatory Commission shall be notified within four hours via the Emergency Notification System. In addition, when the vibration on any pump exceeds 8 mils due to a shaft crack or unknown cause, within four hours the affected pump shall have its orbit and spectra continuously monitored and evaluated by an appropriately qualified individual.
 - d. When any one vibration monitor on the reactor coolant pumps indicates a vibration level of 10 mils or greater, within one hour, initiate action to place the unit in at least HOT STANDBY within the next six hours, and at least COLD SHUTDOWN within the following 30 hours. In addition the affected pump shall be secured after entering Hot Standby (Mode 3).

DRAFT



- e. On a daily basis a spectrum analysis shall be performed on the reactor coolant pump shaft vibration data and shall be evaluated for trends by using an individual qualified in that technique. The evaluation shall consist of comparing the running speed (1xRPM) and twice running speed (2xRPM) spectral components to limits computed from the baseline vibration. The limits shall be based on the lowest of: (a) 1.6 times the baseline value; (b) the mean plus three standard deviations; (c) 2 mils for the 2xRPM component; or (d) 6 mils for 1xRPM component. When the amplitude exceeds any limit, further analysis shall be performed. This analysis shall consist of an inspection of the amplitude versus time plots for a steadily increasing trend, and a review of other plant data which might explain the change in amplitude. If it is confirmed that the trend is not caused by plant or pump conditions unrelated to a shaft crack, the trend shall be extrapolated manually and/or by computer to predict the time at which the vibration is expected to reach 10 mils. If the projected time for reaching 10 mils is one week or less, the Unit shall be brought to Hot Standby pursuant to item d above and the affected pump shall be secured. After reaching Hot STANDBY, the Unit shall proceed to COLD SHUTDOWN within the following 30 hours.

The Regional Administrator, Region V may relax or rescind, in writing, any of the above vibration monitoring conditions upon a showing by the licensees of good cause.

4. Within 90 days of the commencement of the Palo Verde Unit 2 first refueling outage, the licensee shall submit a report to the NRC concerning the inspection of the Unit 2 reactor coolant pumps. This report shall include inspection results, an evaluation of the Unit 1 and Unit 2 pump shaft degradation findings and proposed actions to be taken with respect to Unit 3 continued operation.
5. APS shall install modified reactor coolant pump shafts during the first refueling outage which include the modifications described in Figure DES-3 of the attachments to the licensees' November 5, 1987 letter.

1/ In the event new limit methods are chosen, they shall be evaluated by the licensee to assure that the new methods are equal to or better than the above method. The Commission shall be advised within one week if new methods are chosen.

